Practical Computing

80p

July 1982

Volume 5 Issue 7

Clive Sinclair interviewed

Reviews:
ZX Spectrum
Atari graphics
Qume Sprint 9

CP/M file copying
Micro ergonomics
Structured Basic

Cromemco System One

MicroCentre introduce Cromemco's new System One computer, available with an integral 5 megabyte Winchester hard disk, at a new low price.

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2114L-200n	80
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2532-450n	365
2564	£14
2708	225
2716-5V	225
2732-450n	400
2764	£17
4027	240
4116-150n	95
4116-200n	80
4118-250	325
4164-200	620
4315-4K	795
4334-3	
(CMOS2114)	325
4816A-120n	225
5101	270
4864-3	785
6116-150nS	420
6117-150N	480
6502-CPU	399
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6504-250	560
6521	150
6522 VIA	350
6530 RR10T	£12
6532 R10T	625
6545 CRTC	£10
6551 ACIA	650
6592-PC	£20
6800	300
6802	400
6803	850
6804	160
6805	670
6808	520
6809	895
6810	120
6821	125
6840	385
6843	£12
6845	685
6847	850
6850	140
6852	255
6875	500
8080A	350
8085A	550
81LS95	90
81LS96	90
81LS97	90
8123	125
8155	475
8202	£25
8212	170
8214	425
8216	70
8224	200
8226	250
8228	250
8251	320
8253	799
8255	295
8257	800
8T26A	699
8T27	150
8T28A	140
8T31	350
8T95N	99
8T97N	99
9364AP	550
AM26LS31C	125
AM26LS32A	125
AY-3-1015	300
AY-3-8910	440
AY-3-8912	625
AY-5-1013	300
AY-5-2376	600
COM8116	755
AS3691N	00
AS88LS120N	00
FD1771	£18
FD1791	£28
FD1793	£30
FD1795	£30
FD1797	£35
INS8060N	£13
INS8154	£10
IM6402	380
MC1488	55
MC1489	55
MC14411	695
MC14412	795
MC3447P	315
MM5280D	695
MM58174	825
MM74C922	420
RO-3-2513L	700
RO-3-2513U	600
SFF96364E	800
TMS2716-3V	875
TMS6011	365
ULN2003	100
ULN2004	90
UPA7002	438
Z80CPU2.5	350
Z80ACPU4M	355
Z80P10	290
Z80AP10	320
Z80CTC	300
Z80ACTC	325
Z80DMA	10

Z80S10-1	690
Z80AS10	750
Z80DART	440
Z80ADART	450
ZNA234E	905
ZN41SCE	190
ZN423E	138
ZN424E	130
ZN425E	345
ZN426E	300
ZN427E	600
ZN428E	478
ZN429E	210
ZN1034E	200
ZN1040E	675
74S132	110
74S138	180
74S188	210
74S189	158
74S194	320
74S201	350
74S241	390
74S262	850
74S287	300
74S288	210
74S470	325
74S471	620
74S472	1150
74S475	825
74S571	620
75107	8125
75108	95
75182	99
75183	99
75154	150
75188	55
75189	55
75322	140
75450	80
75451/2	52
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75491/2	65

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7400	11
7401	11
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7403	12
7404	13
7405	15
7406	20
7407	20
7408	14
7409	14
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7427	22
7428	25
7430	14
7432	22
7433	22
7437	25
7438	25
7440	15
7441	68
7442	32
7443	90
7444	90
7445	55
7446	60
7447	40
7448	45
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7473	24
7474	20
7475	40
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7484	70
7485	60
7486	20
7489	205
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74111	55
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74141	55
74142	175
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74144	210
74145	50
74147	90
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74166	48
74167	150
74170	120
74172	275
74173	60
74174	54
74175	50
74178	40
74177	45
74178	80
74179	80
74180	40
74181	115
74182	60
74184	90
74185	95
74186	470
74188	250
74190	48
74191	46
74192	46
74193	45
74194	45
74195	46
74196	46
74197	46
74198	84
74199	84
74221	54
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74251	65
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74490	90

74LS	
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LS49	50
LS51	14
LS54	14
LS55	14
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LS78	18

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LS96	95
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LS126	25
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LS133	30
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LS148	73
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LS153	40
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LS273	60
LS275	225
LS279	30
LS280	130
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LS290	45
LS293	40
LS295	86
LS298	85
LS299	190
LS320	270
LS323	195
LS324	168
LS325	295
LS326	240
LS327	240
LS347	95
LS348	125
LS352	88
LS353	88
LS362	750
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LS366	30
LS367	30
LS368	40
LS373	65
LS374	65
LS375	43
LS377	70
LS378	60
LS379	65
LS384	395
LS385	250
LS390	50
LS393	45
LS395	125
LS399	175
LS445	100
LS471	620
LS490	200
LS540	130
LS541	120

LS640	180
LS641	180
LS642	165
LS645	180
LS668	125
LS669	120
LS670	150
LS669	95
LS673	550

CMOS	
4000	10
4001	10
4002	12
4006	50
4007	15
4008	48
4009	24
4010	24
4011	11
4012	16
4013	25
4014	50
4015	50
4016	20
4017	38
4018	45
4019	25
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4021	50
4022	50
4023	16
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4026	80
4027	24
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4030	30
4031	125
4032	80
4033	125
4034	140
4035	65
4036	275
4037	110
4038	110
4039	290
4040	50
4041	60
4042	45
4043	50
4044	50
4045	105
4046	65
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4057	1915
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4062	995
4063	85
4066	30
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4070	15
4071	15
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4073	15
4075	15
4076	46
4077	18
4078	18
4081	16
4082	16
4085	50
4086	52
4089	125
4093	26
4094	120
4095	75
4096	70
4097	290
4098	75
4099	75
4160	95
4161	99
4162	99

4163	99
4174	99
4175	105
4194	105
4408	790
4409	790
4410	725
4411	675
4412	775
4415	480
4419	280
4422	770
4433	770
4435	850
4440	999
4450	350
4451	350
4490	350
4500	675
4501	28
4502	60
j10344503	40
4504	75
4506	35
4507	35
4508	130
4510	46
4511	45
4512	50
4513	199
4514	115
4515	115
4516	55
4517	275
4518	40
4519	30
4520	50
4521	110
4522	125
4526	70
4527	65
4528	70
4529	150
4530	90
4531	130
4532	70
4534	455
4536	275
4538	90
4539	110
4541	140
4543	80
4544	150
4549	375
4553	245
4554	190
4555	35
4556	35
4557	320
4558	120
4559	395
4560	160
4561	104
4562	495
4566	165
4568	195
4569	175
4572	28
4580	460
4581	250
4582	95
4583	90
4584	48
4585	86
4597	330
4598	290
4599	290
40097	58
40100	215
40101	130
40102	150
40103	175
40104	95
40105	115
40106	50
40107	60
40108	450
40109	98
40110	270
40114	240
40163	65
40174	60
40181	150
40182	95
40192	95
40193	68
40194	95
45106	595

WATFORD'S UNIVERSAL MICRO EXPANSION SYSTEM

Designed by Walford Electronics, this extremely versatile and economical Expansion System as published in E.T.I., starting from Dec. 1981 issue, offers a low cost flexible expansion system for ZX81, UK101, SUPERBOARD, ACORN ATOM, PET, TANGERINE, etc.

The Motherboard (interfaces with the computer) has capacity to accept up to five daughter cards and can be paralleled for even more daughter cards.

All PCBoards are of computer grade finish and are supplied in kit form.

Just look at the Expansion possibilities.

MOTHERBOARD — Accepts up to five daughter cards. Full kit: £36.50

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PROM PROGRAMMER — This simple but extremely useful card can blow 2716r single rail EPROMS. (2732) Full Kit: £25.95

PROM CARD — PCB cards for housing four 2716 or two 2732 EPROMS.
(4 x 2716) Full Kit: £11.95
(2 x 2732) Full Kit: £11.75

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Price only £15

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As reviewed in PE September 1981. The complete microprocessor development system for Engineers & Beginners. New powerful instruction. Accepts any 24 pin 5V single rail EPROM. Supplied fully built, tested & enclosed in a black ABS case. Price incl. encapsulated plug-in power supply. £169

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2732	400p	375p
4116	75p	68p
4334-3	325p	290p
4816 (BBC)	225p	210p
6116-150nS	420p	398p
6522	320p	295p
6520	150p	125p
6820	150p	125p

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- **MX80T** 10" Tractor Feed, 9x9 matrix, 80 column Speed 80 CPS bi-directional Centronics Interface, Baud rate 110-9600. (RS232) £299 + p&p
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- **UHF Modulator 8MH2** 450p
- **Stack Pack 5** Drawers (10 sections) Cassette racking Unit £2
- **Stack Pack Unit** incl. 10 C12 Cassettes 550p

CRYSTALS			
32.768KH	100	7.168MHz	160
100KHz	270	7.68MHz	200
200KHz	295	8.0MHz	150
455KHz	375	8.08333	395
1MHz	295	8.867237	175
1.008M	290	9.0MHz	200
1.6MHz	392	9.375M	350
1.8MHz	395	10.0MHz	175
1.843M	220	10.7MHz	150
2.0MHz	240	10.24MHz	200
2.4576M	220	12.0MHz	290
3.2768M	150	12.528M	300
3.57594M	98	14.31818	170
3.6864M	300	16.0MHz	250
4.0MHz	150	18.0MHz	180
4.032M	290	18.432M	150
4.80MHz	200	19.968M	150
4.1943M	200	20.0MHz	325
4.433619	120	24.0MHz	170
5.0MHz	160	24.930M	325
5.185M	300	26.67M	150
5.24288	390	27.125M	325
6.0MHz	140	27.145M	295
6.144MHz	225	38.6667	190
6.5536M	200	48.0M	175
7.0MHz	150	100.0M	375
		116.0M	300

IDC CONNECTORS

(Speed Block type)	PCB Plug with latch Strt	Angle	Header socket	PCB Pins Strt	Angle
	Pins	Pins			
2x5 way	90p	99p	85p	60p	65p
2x8 way	130p	150p	110p	70p	78p
2x10 way	145p	166p	125p	80p	92p
2x13 way	175p	200p	150p	95p	110p
2x17 way	205p	236p	160p	110p	135p
2x20 way	220p	250p	190p	125p	150p
2x25 way	235p	270p	200p	150p	175p

JUMPER LEADS: Ribbon Cable Assembly DIL Plug (Headers)

Single Ended Lead, 24" Long Length	14pin	16pin	24pin	40pin
24"	145p	165p	240p	380p
Double Ended Leads				
6"	185p	205p	300p	465p
12"	198p	215p	315p	490p
24"	210p	235p	345p	540p
36"	230p	250p	375p	595p

ID Header Socket Jumper Leads

24"	20pin	26pin	34pin	40pin
1 end	160p	200p	260p	300p
2 ends	290p	370p	480p	525p

DIL SOCKETS

	Low Prof	Wire Wrap
8pin	8p	25p
14pin	10p	35p
16pin	10p	42p
18pin	16p	52p
20pin	22p	60p
22pin	25p	70p
24pin	25p	70p
28pin	28p	80p
40pin	30p	99p

RIBBON CABLE

Ways	Grey Price/foot	Colour
10	12p	22p
20	25p	40p
26	35p	52p
40	55p	70p

DIL PLUGS (Headers)

	Soldr	IDC
14pin	44p	100p
16pin	49p	120p
24pin	88p	170p
40pin	250p	265p

AMPHENOL PLUGS

24way IEEE	575p
34 way Centronics Parallel	550p

ZIF DIL SOCKETS

24way	575p
28way	850p
40way	375p

VIC 20
Micro Computer
Ready built, tested and elegantly cased. Connects directly to a colour TV. Has 5K RAM expandable to 32K Available ex-stock £165

CASSETTE Deck for above including a free 6 program Cassette £39

EURO CONNECTORS

DIN	Socket Pins	Plug Pins	Plug Strat Angle
41618			
31 way	180p	—	195p
41612A+B			
2 x 32 way	290p	220p	235p
41612A+C			
2 x 32 way	310p	225p	240p
41612A+B+C			
2 x 32 way	380p	245p	280p

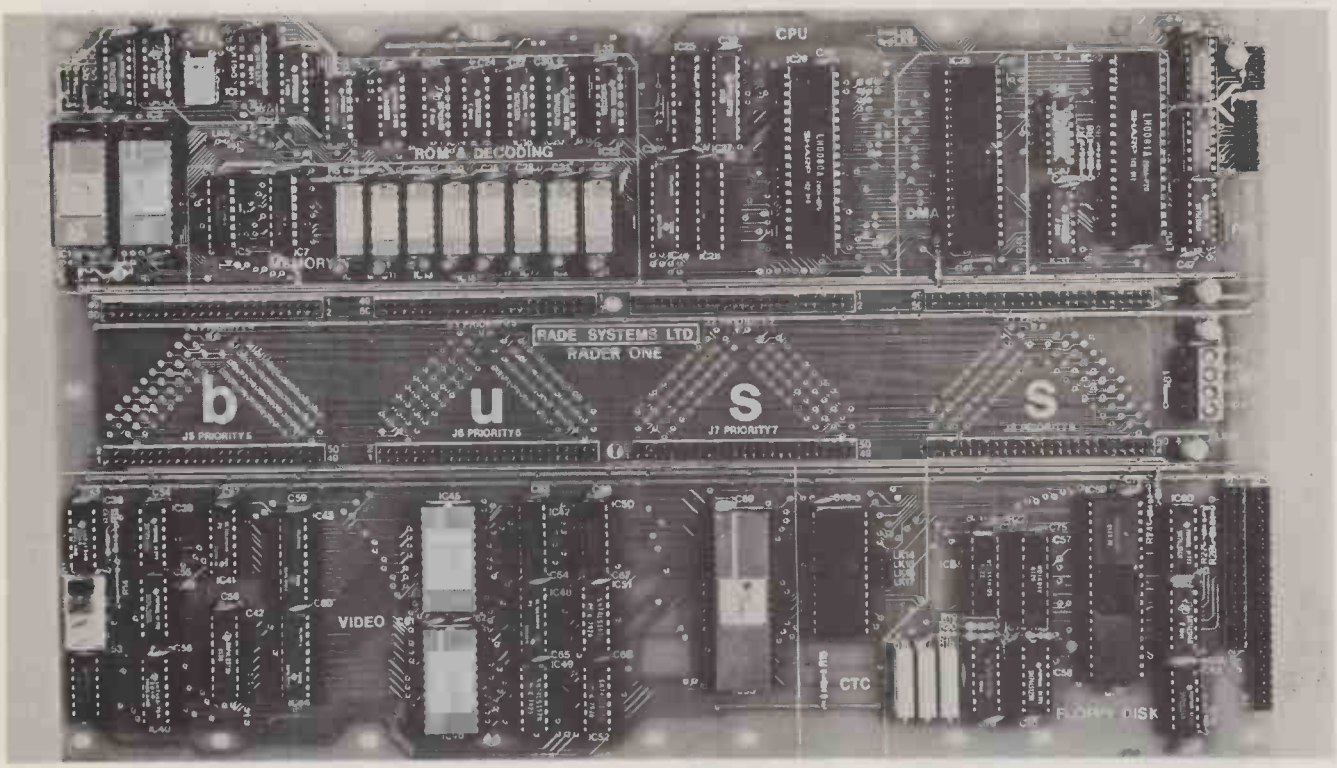
EDGE CONNECTORS

(Double type)	1"	.156"
2x10way	—	135p
2x15way	—	140p
2x18way	180p	145p
2x22way	199p	200p
2x23way	210p	—
2x25way	225p	—
2x30way	245p	—
2x36way	295p	—
2x40way	315p	—
2x43way	395p	—
2x75way	550p	—

D CONNECTORS: Miniature

Plugs	9 way	15 way	25 way	37 way
Solder	80p	110p	160p	250p
Angle	160p	210p	250p	355p
Pins	120p	130p	195p	295p
Solder	110p	160p	210p	350p
Angle	165p	215p	290p	440p
Pins	150p	180p	240p	420p
Covers	100p	95p	100p	110p

OEM's This is Your Board



The RADER single board computer has been developed in the U.K. and tailormade to offer the user the most up-to-date techniques of microprocessor technology coupled with the built in facilities of ultimate expandability and flexibility.

Based on the popular Z80A Microprocessor running at 4 MHZ, up to 16K of internal ROM may be addressed. 2K of video RAM and 2K of character generator RAM is included (both memory mapped). Decoded bank switching permits the addition of as many boards as may be required, each board containing 3 pages of 64K RAM, giving unlimited capacity. A highly flexible memory capability is achievable by the addition of external pages of ROM.

Floppy Disc interface utilises Western Digital's 1797 Disc Controller allowing interfacing to 5¼" or 8" floppy disc drives, side selection for double sided drives and single or double density recording. All data transfers are accomplished by the on-board DMA controller. Other standard features include: On board keyboard port, composite video output and "disc mains" on/off signals; light pen input; inverse video switch to select normal video display background (white on black/black on white); video enhancements switch; plus choice of invert character or dual intensity enhancements.

Monitor with full screen editing facilities plus a full 8 point cursor control. ● Autoboot for business systems ● Autoselect for varying disc densities ● Ability to auto-load extra ROM ● Commands: Dump, boot, edit, input port/output port, break point, go to, copy.

The board is configured to run the latest CPM version 2.2 and ideally suited as the basis for small to medium business machines, games machines, industrial control machines, research and development equipment ● **Board Price £350 plus £4.00 P+P excluding VAT.** (Please state whether 8" or 5¼" board is required.)

Standard features

- 64K RAM
- 4 MHZ Z80A CPU
- 5¼" or 8" Disc Interface, single/double/sided density
- Z80A CTC (clock/timer/counter)
- DMA Controller
- Memory Mapped Video Display
- Memory Mapped RAM Character Generator
- Programmable Video Controller
- 8 Expansion Connectors

Add on option boards

- Dual Parallel Ports **£35**
- Dual Serial Ports **£50**
- Cassette Interface **£50**
- RAM Expansion Board, Capacity 192K, in 64K Increments **£250**
- User Prototyping Board **£16.75**
- Real time clock with battery back-up **£45**

All option boards; add **£2.00 P+P**
Prices exclude VAT.

Configuted to run CPM 2.2

- CP/M DOS also includes a utility programme that allows you to format your discs and dynamically configure the systems for a variety of disc and printer types. A set of manuals are also included.

Price £100 plus £3.00 P+P. Send for complete technical specification. All prices excluding VAT.

- Full Custom software development support available

Rade Systems Ltd.,
53-55 Ballards Lane,
London N3 1XP
Telephone 01-349 4711/5
Telex 46523 Simsys G.

RADE
Dedicated Intelligence

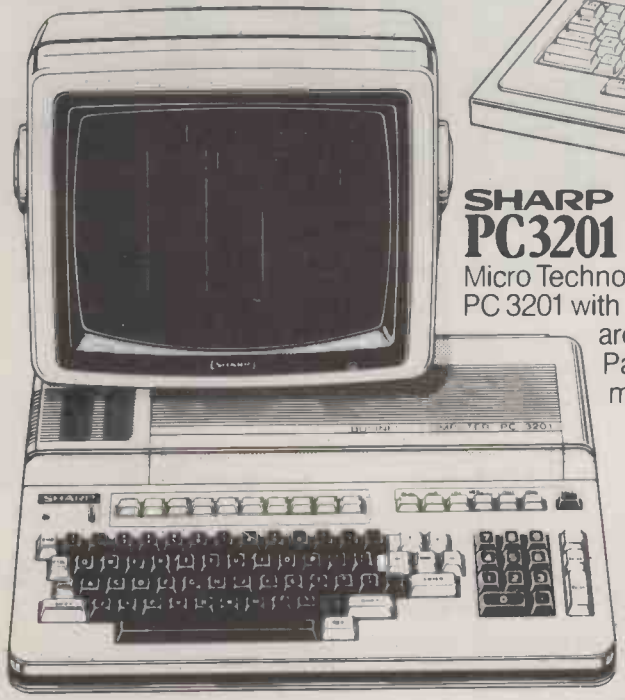
● **Circle No. 103**

WE PUT CP/M TO WORK ON SHARP

Micro Technology, the people who put CP/M on the Sharp MZ-80B, and on the all-new MZ-80A, have achieved the near impossible and produced CP/M on the PC 3201; plug our board into the back of your PC 3201 and you can run standard 64k CP/M and use the vast library of CP/M software that Micro Technology can supply.

Now look at Sharp equipment, with all machines offering CP/M and integration using CP/NET and MP/M, you can network together the economy of the MZ-80A, the speed and graphics capability of the MZ-80B and the superbly attractive business presentation of the PC 3201.

SHARP MZ80B Highly flexible micro computer with 64k RAM, disks or tape; high resolution graphics and CP/M.



SHARP PC3201 And newly available from Micro Technology, a plug-in board that allows you to run your PC 3201 with standard 64k CP/M. All CP/M products on our list are now available, including the superb new Padmede/Micro Technology business packages, all making the PC 3201 an excellent business machine.

SHARP MZ80A The newest Sharp machine, bristling with features, equally at home in a domestic or a business environment. Now with CP/M.

If you're interested in the hardware as well – then please call us.

Just check through our list of software

WORDSTAR Powerful word-processing package, made easy to use by full function key support on the MZ-80B. **£242**

MAILMERGE Add on to WORDSTAR, provides mail-shot and text inclusion. **£73**

SPELLSTAR Add on to WORDSTAR, for spelling checking. **£121**

DATASTAR Screen oriented form definition and data entry tool. **£171**

SUPERSORT I Powerful disk based sort package. Stand alone program and MICROSOFT compatible CALLING SEQUENCE RELOCATABLE ROUTINES. **£122**

SUPERSORT II As SUPERSORT I, but only the stand alone program. **£97**

WORDMASTER Superb screen based text editor, all functions driven by MZ-80B function keys. **£73**

CALCSTAR The new financial planning package from the MICROPRO stable. **£144**

EASYFILER Flexible data definition, data entry, data update and report generator. **£150**

GENISYS General insurance system for office admin and accounting of general insurance broker. **£1000**

EMIS Estate agent management information system. Designed by estate agents for estate agents. **£795**

COMAL-80 The revolutionary structured programming languages, easy to use as BASIC. Recommended for education and teaching environment. **£130**

BASIC-80 Accepted standard Microprocessor based BASIC interpreter. **£175**

BASIC COMPILER BASIC-80 compatible compiler, makes BASIC programs run many times faster. **£200**

FORTRAN-80 ANSI standard FORTRAN, except for COMPLEX numbers. **£200**

COBOL-80 1974 ANSI standard COBOL, with large program chaining and screen DISPLAY/ACCEPT. **£300**

M/SORT Powerful sorting facility for use primarily with COBOL-80. **£75**

Mu-MATH & MuSIMP Symbolic math package, allows computation on to 611 arithmetic digits. Superb for scientific and engineering applications. **£149**

Mu-LISP & Mu-STAR Extended LISP 1.5. Includes screen based LISP environment editor. **£119**

EDIT-80 & FILCOM Line oriented random access text editor. Includes source and binary file compare program. **£71**

MACRO-80 Assembler with Z80 mnemonics. Includes linking loader, library manager and cross referencer. **£119**

CIS COBOL ANSI 74 standard COBOL to full level 1 standard. **£425**

FORMS-2 For use with CIS COBOL, provides superb screen handling capability for CIS COBOL programs. **£100**

PROSPERO PRO PASCAL Fastest Z80 PASCAL we know. **£190**

PL/1-80 ANSI standard subset G based PL/1 producing direct object code for fast execution. **£298**

BT-80 Record retrieval system or use with PL/1-80, to give data base management facilities. **£119**

MAC Upward compatible assembler from ASM, provides MACROs and Z80 assembly support. **£53**

ZSID Super symbolic debugger, with full Z80 mnemonic support. Works well with MACRO-80. **£59**

TEX Text formatter ideal for producing manuals and similar documents. Note this is not screen based. **£59**

DESPOOL Allows listing of files at same time as other processing. **£29**

CBASIC Commercial BASIC, used extensively for business packages. **£65**

CB80 Full compiler for CBASIC. **£298**

MINI MODEL Very powerful professional financial modelling package. **£399**

MAGSAM Indexed sequential access routines, for use with CBASIC. **£110**

BASKAM Basic keyed access routines for use with BASIC-80. **£95**

DATAFLOW Easy use data file entry tool. For reports, labels or MICROPRO MAILMERGE compatible files. **£99**

PADMEDE/MICRO TECHNOLOGY A full range of business software converted by us from the highly reliable PADMEDE originals to run under CP/M.

SALES LEDGER SYSTEM Fully integrated, secure, parameterisable with full report facilities. **£249**

PURCHASE LEDGER SYSTEM All the same flexibility as the sales ledger system. **£249**

SALES INVOICING SYSTEM Automatic product description access, audit trail, instantly updatable product file (even while creating an invoice). Integrates with sales ledger system if required. **£249**

NOMINAL LEDGER SYSTEM Integrates all the sales and purchase side of your business. Trial balances can be produced for incomplete records accounting. **£249**

STOCK CONTROL SYSTEM Full stock control system with minimum stock levels and re-order levels. Integration to sales invoicing system provided. **£249**

MICRO TECHNOLOGY MICROTEXT Easy to learn and easy to use text processor with far more friendly user interface than WORDSTAR. If you wish to use it, then far more power is available to you, including calculator, column and row totalling and macro-text functions. **£270**

MICROMERGE Integrate and merge facility for use with MICROTEXT. Use for mailshots and simple database retrieval and reporting. **£70**

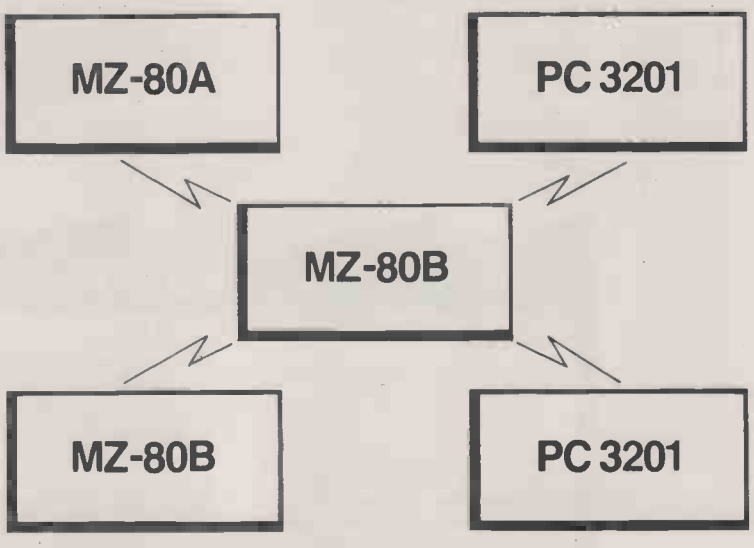
EXPAND Library routines for use with MICROSOFT calling sequence products. Gives MZ-80B graphics, cassette and music handling. **£65**

Free with any MICROSOFT product purchased at the same time from us.

Please state for which machine /version of CP/M the product is intended.

CASH WITH ORDER for goods by return. Post & packing at £2 per item + VAT @15%. All orders sent 1st class post.

NOW WE HAVE ADDED 6 TO 24 Mb WINCHESTER DISKS, MP/M AND NETWORKING ON SHARP AS WELL!



6 Mb Winchester hard disk – £1930
12 Mb Winchester hard disk – £2475
18 Mb Winchester hard disk – £3020
24 Mb Winchester hard disk – £3565
*Integral floppy back-up unit – £400
*Clock option
(improves MP/M performance)– £25
RS232C card for MZ-80A or MZ-80B fully program controlled up to 19,200 baud, dual RS232 or EIA – £150

*Must be ordered with disk unit.

Totally flexible networks of any mix of up to 4 MZ-80As, MZ-80Bs and PC 3201s on an active network, communicating at speeds of up to 19,200 baud or miles apart.

MP/M – £350 CP/NET – £250

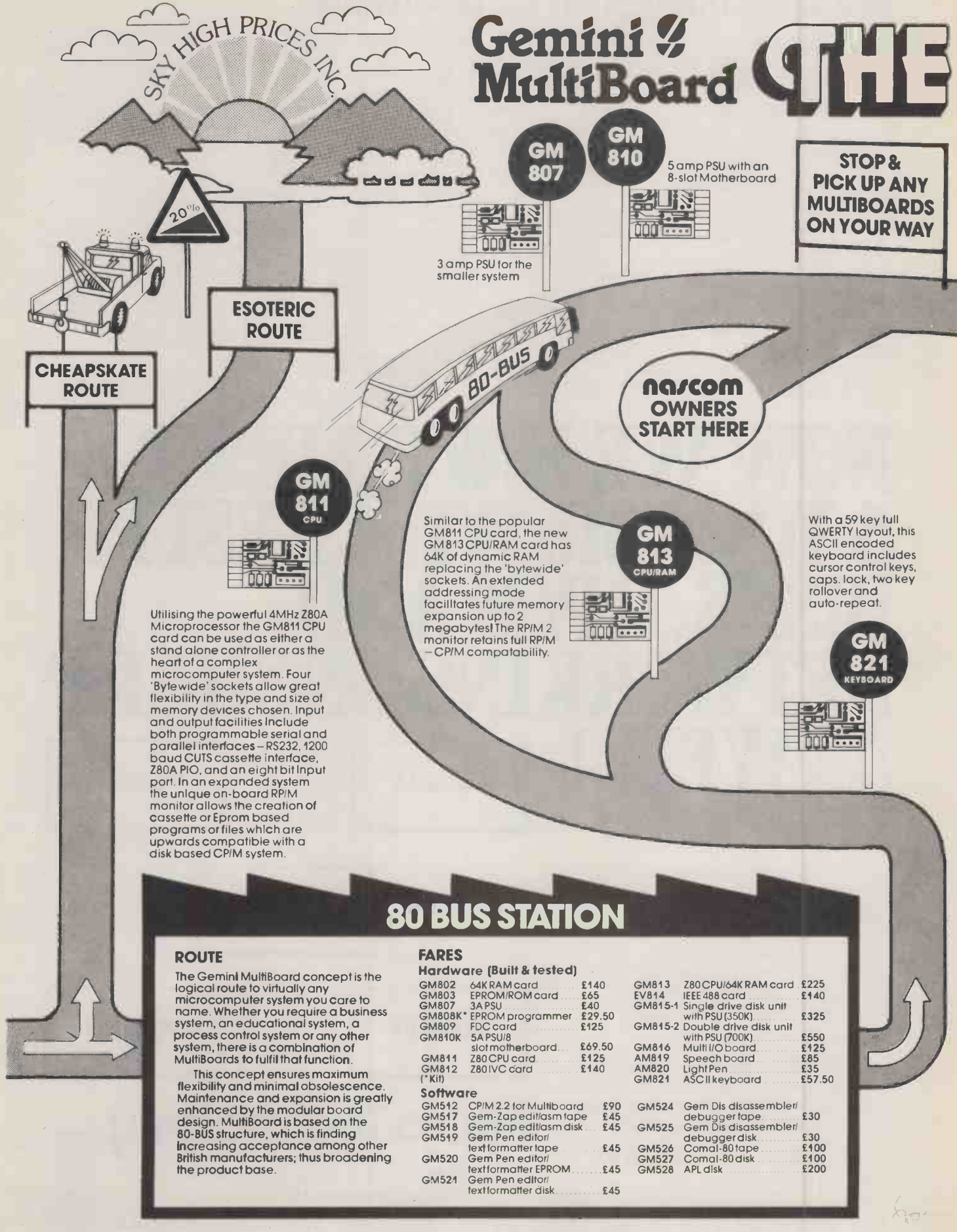
Dealer enquiries welcomed.

CP/M, MP/M & CP/NET are trade marks of Digital Research.

Micro Technology
LIMITED
51/53 The Pantiles, Tunbridge Wells, Kent TN2 5TH.
Telex 95441 MICRO-G

Ask your dealer for details or call us on Tunbridge Wells (0892) 45344.

● Circle No. 104



80 BUS STATION

ROUTE

The Gemini MultiBoard concept is the logical route to virtually any microcomputer system you care to name. Whether you require a business system, an educational system, a process control system or any other system, there is a combination of MultiBoards to fulfil that function.

This concept ensures maximum flexibility and minimal obsolescence. Maintenance and expansion is greatly enhanced by the modular board design. MultiBoard is based on the 80-BUS structure, which is finding increasing acceptance among other British manufacturers; thus broadening the product base.

FARES

Hardware (Built & tested)

GM802	64K RAM card	£140
GM803	EPROM/ROM card	£65
GM807	3A PSU	£40
GM808K*	EPROM programmer	£29.50
GM809	FDC card	£125
GM810K	5A PSU/8 slot motherboard	£69.50
GM811	Z80 CPU card	£125
GM812 (*Kit)	Z80 IVC card	£140
GM813	Z80 CPU/64K RAM card	£225
EV814	IEEE 488 card	£140
GM815-1	Single drive disk unit with PSU (350K)	£325
GM815-2	Double drive disk unit with PSU (700K)	£550
GM816	Multi I/O board	£125
AM819	Speech board	£85
AM820	Light Pen	£35
GM821	ASCII keyboard	£57.50

Software

GM512	CP/M 2.2 for Multiboard	£90
GM517	Gem-Zap edit/asm tape	£45
GM518	Gem-Zap edit/asm disk	£45
GM519	Gem Pen editor/ text formatter tape	£45
GM520	Gem Pen editor/ text formatter EPROM	£45
GM521	Gem Pen editor/ text formatter disk	£45
GM524	Gem Dis disassembler/ debugger tape	£30
GM525	Gem Dis disassembler/ debugger disk	£30
GM526	Comal-80 tape	£100
GM527	Comal-80 disk	£100
GM528	APL disk	£200

LOGICAL ROUTE

GM 812 –IVC

The GM812 Intelligent Video Controller card features an on board Z80A processor to provide independence of the host processor and the ability to redefine the functions and parameters of the display.

Normally used in an 80 x 25 mode the card contains a programmable character generator allowing three additional modes of operation – inverse characters, 160 x 75 block graphics, or user defined characters.

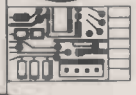
A keyboard socket allows buffered character input, and a light pen socket is provided for specialist applications. Being I/O mapped the card does not occupy any system memory space.

GM 809 FDC

The GM809 floppy disk controller card can support up to four disk drives in either single or double density modes. The card uses the Western Digital 1797 controller and has variable write precompensation and phase locked loop data recovery circuitry.

GM 815 Drive unit

The GM815 floppy disk housing contains one or two 5¼" double density, double sided Pertec FD 250 drives. This gives a storage capacity of 350K per drive. Power for the drives is provided by an integral supply unit.



AUTO-EXCHANGE
All your RP/M software automatically transferred to CP/M

GM 802 RAM

The GM802 RAM board provides a full 64K of dynamic memory. The 80 BUS RAMDIS signal is fully supported so that any EPROM in the system is given priority over the RAM, preventing any possibility of bus contention. Page Mode is also supported by the card which, with the appropriate software, allows up to four memory boards to be used in a system.

FILL-UP WITH SOFTWARE

RP/M

RP/M software is available on tape and includes Editor/Assembler; Text Editor/Formatter; Disassembler/Debugger; Pascal and Comal-80. These packages can also be run under CP/M.

CP/M 2·2

A CP/M 2.2 package is available with the GM 809 card and Pertec drives. On-screen editing auto single/double density selection and parallel or serial printers are supported. Running under CP/M is a wide range of utilities, application software and languages.

ONE WAY

GM 803 EPROM BOARD

The GM803 Eprom Board will accept up to 16 2708 or 2716 Eprom devices. This allows the addition of up to 32K of firmware to the system. The board supports the Page Mode system and consequently need not occupy any memory space when not in use.

GM 816 I/O BOARD

The Gemini I/O board provides a unique solution for interfacing to "the real world". The board contains 3 PIO's, a CTC and a real time clock with battery back up. "Daughter" boards may also be added and these include A-D, D-A, opto-coupling and serial interface boards.

A number of manufacturers are busy working on additional 80-BUS boards which will progressively increase the potential of your MultiBoard system.

MEN AT WORK

PROTO-TYPING BOARDS

80 BUS compatible prototyping boards are available from both Vero and Winchester Technology. These allow the user to easily add a card of their own design to the system.

GM 808 EPROM PROGRAMMER

The GM808 Eprom programmer connects to the PIO on the CPU card and allows the user to program 2708 or 2716 type Eproms.

AM 819 SPEECH BOARD

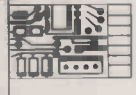
The Arlon Microelectronics speech board utilises the National Semiconductor Digitalker chip set. This gives a vocabulary of over 140 words and sub sounds. Output is from an on-board speaker.

AM 820 LIGHT PEN

This low cost light pen can be used with the GM812 IVC for many applications, including answer selection, editing, menu selection and movement of displayed data blocks.

EV 814 IEEE 488

The EVC IEEE 488 Controller card has been designed to fully implement all IEEE 488 interface functions. This card gives the user a very versatile method of controlling any equipment fitted with a standard IEEE 488 or GPIB interface at minimal cost.



GEMINI MULTIBOARDS – BUY THEM AT YOUR LOCAL MICROVALUE DEALER

All the products on these two pages are available while stocks last from the MicroValue dealers listed on right (Mail order enquires should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome.

INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road, Amersham, Bucks.
Tel:(02403) 22307. Tlx:837788.

COMPUTER INTERFACING & EQUIPMENT LTD.,
The MICRO-SPARES Shop,
19 Roseburn Terrace,
Edinburgh EH12 5NG
Tel: (031) 337 5611

E. V. COMPUTING
700 Bumage Lane, Bumage,
Manchester M19 1NA.
Tel:(061) 431 4866.

ELECTROVALUE LTD.
28 St Judes, Englefield Green,
Egham, Surrey TW20 0HB.
Tel:(0784) 33603. Tlx:264475.

SKYTRONICS,
2 North Road, The Park,
Nottingham.
Tel: (0602) 45053/45215

TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel:(0272) 421196.

BITS & PC'S
4 Westgate, Wetherby,
W.Yorks.
Tel:(0937) 63774.

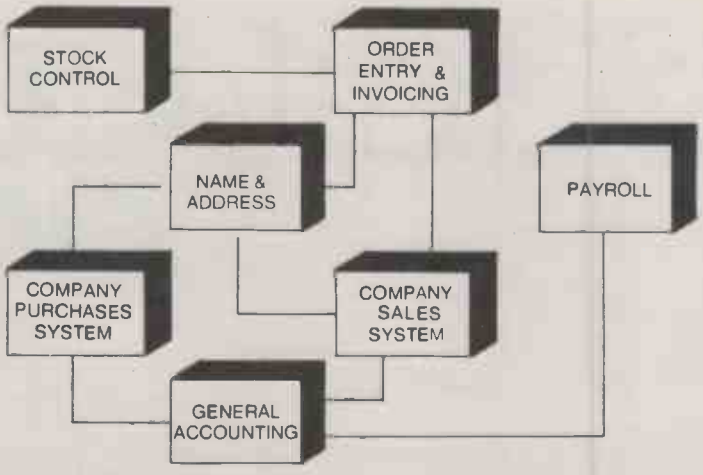
HENRY'S RADIO
404 Edgware Road, London W2.
Tel:(01) 402 6822.
Tlx:262284 (quote ref:1400).

LEEDS COMPUTER CENTRE,
62 The Balcony,
Merrion Centre, Leeds.
Tel: (0532) 458877

● Circle No. 105

ISBS-F

A FULLY INTEGRATED ACCOUNTING SYSTEM FOR THE SMALLER BUSINESS USER. DESIGNED FOR TWIN FLOPPY DISK SYSTEMS



A totally Integrated Small Business System designed for single user floppy disk based systems. Each package can be used stand alone or can be built into an integrated system depending on user requirements. All packages are fully supported and maintained, and are supplied with comprehensive reference manuals. ISBS-F is easy to install and ideal for the first-time small business user with no previous computer experience. Some of the main features of ISBS-F include:

STOCK CONTROL
- Optimum stockholding to keep costs to a minimum.
- Trends shown by monitoring stock movement and showing fast and slow moving lines.
- Accurate stock valuation at any time.
- Fast interrogation of any stock line for answering your customers enquiries.

ORDER ENTRY & INVOICING
- Accurate tracking of orders to make sure all your orders are fulfilled.
- Order acknowledgements to confirm customers orders quickly.
- Automatic reference to the back orders and drawdown of stock when invoicing, to prevent double entry.
- Flexible invoice layout to suit most companies needs.
- Sales analysis reports by product code and your own classification code to provide comprehensive sales monitoring.

NAME AND ADDRESS
- All your customers, suppliers and enquiries stored and maintained by one central system.
- Flexible report generation allowing you to design your own reports.
- Selective mailing labels to make light work of mailshots.

PAYROLL
- Flexible pay periods and methods to suit most professions and industries.
- Comprehensive in year and year end reports to save endless form filling
- Coin analysis for workers paid by cash helping to speed up pay packet preparation.
- Tax or national Insurance updates as and when required to make budget changes easy.
- Overtime and special credits and deductions can be handled with ease.
- Security check prevents unauthorised use.

COMPANY PURCHASES
- Open Item or Balance Forward accounts depending on the nature of the goods being supplied.
- Credit control reports to ensure payments are made within your own target dates.
- Computerised cheque writing to save manual preparation.
- V.A.T. returns can be prepared speedily from V.A.T. analysis reports.

COMPANY SALES
- Invoices can be posted directly from the Order Entry and Invoicing System to save re-entry.
- Open Item or Balance Forward accounts to suit different customer types.
- Statements for your customers can be produced easily and at anytime.
- Comprehensive reports to assist credit control and maintain a healthy cash flow.
- V.A.T. returns can be prepared speedily from V.A.T. analysis reports.

GENERAL ACCOUNTING
- Flexible cost coding system which can be designed for your own company structure.
- Automatic generation of the Profit and Loss Account and Balance Sheet reflecting the financial position of your company at anytime.
- Budget controls over flexible periods to ensure expense accounts are not overrun.
- Data automatically retrieved from the Company Sales, Company Purchases and Payroll Systems which means that data is only entered once.

2020

WP2020 WORD PROCESSOR

WP2020 is an advanced word processing system which runs on selected 8080 based microcomputers. In addition to all the standard features of a word processing system such as margins, tabs, pagination, global search and replace, proportional spacing etc., the system also offers the following:
- Special set of coloured function keytops supplied as standard.
- Menu driven system designed for typists and secretaries — there are no complicated control codes to remember.
- Advanced facilities such as a spelling checker, merge documents module, communications, and integration with ISBS-F supplied as standard.
- Supports background printing whilst working on other documents.

CM 2020 CONFIGURABLE MANAGER

CM2020 is a powerful information retrieval system which the user can configure to suit individual needs. It has been designed for the user without any special computer background. The user has total control over the application environments by defining the basic filing system, input screen formats and output reports. CM2020 is easy to learn and use, an application which might normally require weeks or months without CM2020 can be set up and running in a matter of hours or days. For the technically minded there is also a FORTRAN and RATFOR compiler available so that other programs can be developed to interface with a CM2020 data base. Some of the typical applications for CM2020 would be:
- PERSONNEL MANAGEMENT
- PARTS FILES
- MAILING LISTS
- PROJECT MANAGEMENT
- QUESTIONNAIRE ANALYSIS
- SALES ENQUIRIES AND LEADS

FP2020 FINANCIAL PLANNER

The FP2020 provides a new approach to management planning, whether it is financial, budget, job cost, cash flow, product pricing, engineering etc., FP2020 will accurately forecast the effect of proposed actions. Data is entered interactively having defined the size of the model or 'spreadsheet'. The user can then use the standard functions to calculate cell values or use the special functions (mathematical or statistical) to perform more complex arithmetic. Models and definitions are stored on disk and can be retrieved at a later stage. The user can define his own output reports as required and graphic output can also be obtained.

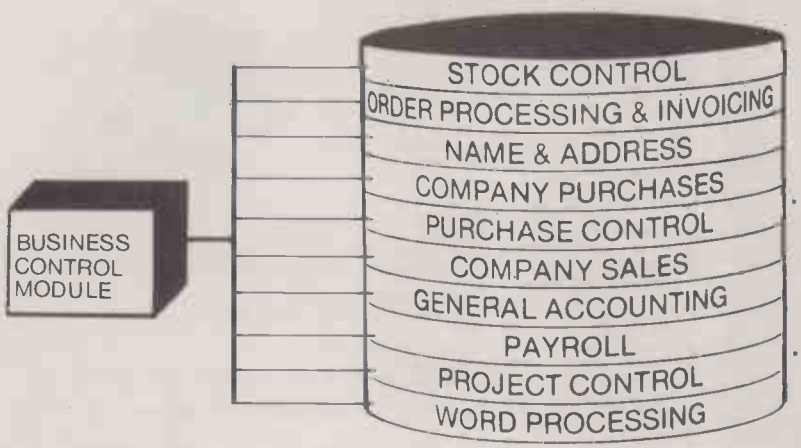
GRAFFCOM SYSTEMS GROUP

Application software for 8 and 16 bit micros

GRAFFCOM SYSTEMS LTD. 102 PORTLAND ROAD, HOLLAND PARK, LONDON W11 4LX TEL: 01-727 5561

ISBS-W

AN INTEGRATED OFFICE ACCOUNTING AND ADMINISTRATION SYSTEM TO MEET MULTIWORKSTATION REQUIREMENTS. DESIGNED FOR HARD DISK BASED SYSTEMS



*Check for release date

A professional Integrated Business System designed for microcomputers which use Hard disks or Winchester disks. ISBS-W is ideal for the small to medium business where data storage and processing speed exceeds the capabilities of floppy disk based systems. Users of ISBS-F can upgrade to ISBS-W as the business expands using GRAFFCOM's System Migration Plan — SMP. The user can choose from any combination of modules and add others at a later stage if required. All modules are fully maintained and supported and comprehensive documentation is supplied for each application. Some of the main ISBS-W features include:

BUSINESS CONTROLLER
The Business Control Module acts as a task manager and supervisor for the ISBS-W system. It takes care of system definition parameters such as the number of hard disks, numbers of workstations and printers. Operators will feel at ease with the Business Control menu which will prompt for application tasks such as word processing, accounting modules or, order processing etc. The controller will also take care of file protection and authority of access via a password system. It also incorporates a data archieve and retrieval option allowing the user to make back-up copies of the data system as often as required.

ACCOUNTING MODULES
All standard accounting tasks are catered for and include sales, purchases and nominal ledgers. The payroll module is fully supported in terms of legislative changes. Standard managements reports include budgetry control, Profit and Loss Statements and Balance Sheets.

STOCK CONTROL AND ORDER PROCESSING
Orders can be entered as received and the system provides a comprehensive tracking mechanism until all goods have been shipped. Invoice production provides automatic release of stock and drawdown of order items.

WORD PROCESSING
An advanced automated office computer system would not be complete without an integrated word processing module. This module provides all the standard word processing facilities and has in addition a merge document feature for personalised letters and a built-in spelling checker. The word processing terminal will have custom keytops which makes light work of all word processing tasks for the operator.

SPECIAL INTEREST

LEASE, RENTAL & HIRE PURCHASE SYSTEM
The LR & HP System is designed to control agreements and contracts that are payable at regular intervals by fixed amounts. The system, is designed to interface with the ISBS-F Company Sales System and the Name & Address System.

TIME RECORDING SYSTEM
The TRS is designed for those organisations which offer a 'service' rather than a 'product'. Typical users would be Accountants, Solicitors, Management Consultants, Architects, Quantity Surveyors etc. The system controls manhour expenditure and expenses by job or account numbers.

MIPS — MANAGEMENT INFORMATION PLOTTING SYSTEM
MIPS is a standard package which interfaces with ISBS-F, ISBS-W and the 2020 series to produce a range of management graphs and charts. It is designed to support industry standard plotters from the Hewlett Packard and Tektronix range. (Check with us direct for a complete list of supported plotters). Graphics output includes:

- ISBS-F — budget comparisons, sales analysis, cash flow etc.
- ISBS-W — budgetry control, sales and product analysis, cash flow etc.
- FP2020 — various, depending on characteristics of Model.

LINKS PROCESSOR
This is a Interprocessor link program designed to attach two processors back to back for CP/M file transfer. One processor is defined as the master and the second as a slave.

INTEL 8048 ASSEMBLER
The 8048 assembler produces 8048/35 romable machine code. Source input is created using the CP/M editor ED. Output is to disk in Hex format or printed listing.

Software is suitable for use with the following systems:

AI ABC24,26
ARCHIVES
CIFER
COLUMBIA DATA PRODUCTS
CROMEMCO
COMART COMMUNICATOR
DEC VT18X
DURANGO
DYNABYTE
HEATH
HEWLETT PACKARD 125
IBM DISPLAYWRITER
IBM PERSONAL COMPUTER
IMS
MILLBANK
NEC PC8000
NORTHSTAR
PET (with softbox)
RAIR
SHARP
SIRIUS 1
SUPERBRAIN
TANDY MODEL II
TEI
TRANSAM
TVI
XEROX 820
plus many more

For further details on system requirements check with your dealer or call us direct.

For more information on **GRAFFCOM** products please complete the form. ▶

ISBS-F ☐ ISBS-W ☐ 2020 ☐ SPECIAL ☐

NAME..... COMPANY.....

ADDRESS.....

.....

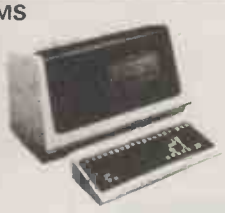
Please tick as required and return to
102 Portland Road, London W11 4LX

GRAFFCOM SYSTEMS GROUP

● Circle No. 106

G. W. COMPUTERS LTD.

TELEVIDEO SYSTEMS



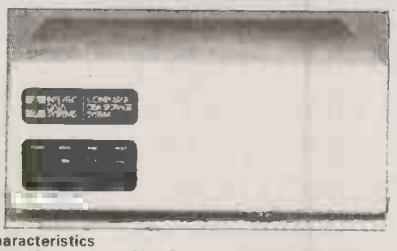
TeleVideo's TS 802 and TS 802H microcomputers are low-cost, powerful single user integrated computer systems. TeleVideo has combined its top of the line CRT display with an advanced design single board computer (Z80, 64K RAM) with 5¼" floppy disks and Winchester hard disk all in one attractive table top enclosure. A detached typewriter-style keyboard is also included. The TS 802 computer features two 5¼-inch floppy disks for 1 Mbyte of on-line storage, and the TS 802H includes one 5¼-inch Winchester disk drive for 10 Mbytes of data storage, and a single 500 Kbyte minifloppy disk unit.

Both the TS 802 and 802H use the industry standard CP/M 2.2 operating system. This lets the user fulfill a wide variety of information and word processing needs using a multitude of commonly available application programs.

TS 802 & 802H Features:

- **Z80A 4 MHz processor with direct memory access**
- **64 Kbytes of RAM main memory**
- **4 Kbytes of EPROM for system diagnostics and boot loading**
- **Dual floppy disk controller (TS 802), and hard disk controller plus floppy disk controller (TS 802H)**
- **Dual minifloppy disks: 1 Mbyte capacity (TS 802)**
- **Single minifloppy disk (.5 Mbyte capacity), plus 10 Mbyte Winchester 5¼-inch hard disk (TS 802H)**
- **Green phosphor CRT (25 rows by 80 columns)**
- **Typewriter-style detached keyboard**
- **Full-screen attributes, editing, smooth scroll, 25th status line, 11 function keys, numeric key pad**
- **2 RS-232C serial ports. These are jumper selectable for any combination of modems or printers**
- **CP/M 2.2 operating system**
- **Attractive tabletop enclosure, fully integrated with CRT, CPU, RAM and disk drives**
- **1 RS-422 high-speed port**

MULTI-USER HARD DISKS



Functional characteristics

The CompuStar 10 megabyte Disk Storage System (DSS) consists of read/write and control electronics, read/write heads, a track positioning mechanism, a spindle drive mechanism, dual disks, an air filtration system, and our exclusive 255 user controller — all packaged in a compact desktop enclosure. Although designed primarily to accommodate multiple CompuStar Video Processing Units (described at left), the unit can easily be connected to a single SuperBrain Video Computer System to facilitate additional disk storage. When used with CompuStar VDUs, however, the integral Z80 based controls will permit up to 255 users to 'share' the resources of the disk with minimal CPU response degradation.

Read/Write Heads and Disks

The recording media consists of a lubricated thin magnetic oxide coating on a 200mm diameter aluminium substrate. This coating formulation, together with the low load force/low mass Winchester type flying heads, permits rellable contact start/stop operation. Data on each disk surface is read by one read/write head, each of which accesses 256 tracks.

G. W. COMPUTERS LTD. 01-636 8210, 01-631 4818, TELEX 892031 TWCG

*** THE NEW DBMS (DATABASE) ***

DBMS2 is a *record relational* as well as a *file relational* database management tool that is capable of being at different times, many different things. The one core program can be set up to perform tasks normally associated with the following list.

Accounting	Budgeting	Cashflow
Stock control	Address mailing	Letter writing
Simulations	Time recording	Filing
Calc-type predictions	Hospital indexing	Profit analysis
Bureaux services	General analysis	Mathematics
Answer *what-if's*	Employees records	Tabulate values
Print reports	Sort files	Edit records

Within hours perform all the above in French or German.
The list is as endless as that which meets the requirements of your own imagination.
Within the appropriate frames of reference you could ask questions like the following:

Find someone whose name contains a W or X or Y or Z, who is either in London or Birmingham, and available for work at a salary of less than 10,000; and is under 40 years of age, not married, of credit worthiness grade 1, with a car, prepared to travel, and who likes horses, does not mind the hours he works, is congenial and has good references. When you find such persons produce a printed list of them showing their names, telephone numbers, and what their salaries are as well as their salary if increased by 10% and show their availability for work. At the end of the list enumerate the total of such persons.

Find all stock items that are codes *micro-computers* that are either in warehouse 1 or warehouse 2, where the quantity on hand is more than 50 units, the cost is less than 1,000, the selling price higher than 2000.00; that are not in cartons, bought from supplier 52, allocated more than 20, rated for tax at 15% and weigh less than 50 lbs. When you find such categories then print a report showing the description, cost price, quantity on hand, lead time for refills, what the selling price *should be if raised by 12.3%* as well as the profit in either per-cent or round figures of that projected selling price.

Find all patients who suffered from cold, that are either girls or women younger than 23 years old, and who live in London at a socio-economic grade higher than 3; do not smoke; have more than 3 children, are currently at work and where treatment failed to effect a cure in under 6 days. When you find such persons then print a list showing their age, marital status, income, and frequency of illness in the past 2 years.

Currently you can ask *7 types* of questions *20 times* for a single selection criterion, and then you can compute *10 mathematical relationships* between the questions for the individual *as well as* for the total number of matches. In all some 60 bits of information relating to one record or a group or records on simply one permutation of the selection criterion, with a cross referencing facility as well.

Every word in the system, as well as the file architectures, print masks, and field attributes, is capable of alteration by you *without* programming expertise (but with some thought).

ALL IN ONE PROGRAM FROM G. W. COMPUTERS. *THE DBMS2 !!*

24 HOUR ANSWERPHONE/LEAVE ADDRESS FOR STANDARD INFORMATION DATA PACK

*** ALL YOU NEED FROM A COMPUTER SYSTEM ***

DATABASE MANAGEMENT + WORD-PROCESSING + MODELLING + DIY INTERPRETER + SERVICE

01-SUPERBRAIN 64K RAM/320 K	1695.00
02-OKI 80 + INTFCE	425.00
03-CABLE	25.00
04-BOX PAPER (2000 SHEETS)	20.00
05-MAGIC WAND (WORD PROCESSOR)	190.00
06-DBMS2 (DATABASE)	575.00
07-MAGIC CALC (MODELLING)	150.00
(NOT INC VAT)	3080.00
DEAL ONE **** 2495.00	**********

01-SUPERBRAIN 64K RAM/320 K	1695.00
02-EPSON MX80F/T2 &INTFCE	475.00
03-CABLES	25.00
04-12 MONTH WARRANTY	220.00
05-DELIVERY IN UK	60.00
06-MEMOREX DISKS (3.00*50)	150.00
07-CPM HANDBOOK	10.00
08-50 BASIC EXERCISES (BOOK)	10.00
09-2000 SHEETS PAPER (BOX)	20.00
10-MAGIC CALC (MODELLER)	175.00
11-MAGIC WAND (W/PROCESSOR)	190.00
12-DBMS2 (INC MBASIC (150.00))	575.00
13-ENHANCED DOS & DIAGNOSTICS	125.00
14-RECOVER & AUTOLOAD	35.00
15-TRAINING SESSION 3-4 HOURS	80.00
16-DISK FULL OF GAMES	50.00
17-CPM ADDITIONAL UTILITIES	150.00
(NOT INC VAT)	4045.00
DEAL TWO **** 2995.00	**********

01-SUPERBRAIN 64K RAM 320/K	1695.00
02-NEC DAISY 3510 PRINTER	1395.00
03-CABLES	25.00
04-12 MONTH WARRANTY	310.00
05-DELIVERY IN UK	60.00
06-MEMOREX DISKS (3.00*50)	150.00
07-CPM HANDBOOK	10.00
08-50 BASIC EXERCISES (BOOK)	10.00
09-2000 SHEETS PAPER (BOX)	20.00
10-MAGIC CALC (MODELLER)	175.00
11-MAGIC WAND (W/PROCESSOR)	190.00
12-DBMS2 (INC MBASIC (150.00))	575.00
13-ENHANCED DOS & DIAGNOSTICS	125.00
14-RECOVER & AUTOLOAD	35.00
15-TRAINING SESSION 3-4 HOURS	80.00
16-DISK FULL OF GAMES	50.00
(NOT INC VAT)	4905.00
DEAL THREE *** 3995.00	**********

01-SUPERBRAIN 64K RAM/700 K	2195.00
02-NEC DR QUME DAISY PRINTER	1695.00
03-CABLES	25.00
04-12 MONTH WARRANTY	410.00
05-DELIVERY IN UK	70.00
06-DYSAN DISKS (6.00*35)	210.00
07-CPM HANDBOOK	10.00
08-50 BASIC EXERCISES (BOOK)	10.00
09-2000 SHEETS PAPER (BOX)	20.00
10-MAGIC CALC (MODELLER)	175.00
11-17 ITEMS ON DEAL TWO ++++++	1205.00
	6025.00
DEAL FOUR *** 6995.00	**********

01-TELEVIDEO 64K RAM/700 K	2395.00
02-NEC DR QUME DAISY PRINTER	1695.00
03-CABLES	25.00
04-S/SHEET FEEDER	750.00
05-TRACTER FEEDER	170.00
06-12 MONTH WARRANTY	500.00
07-DELIVERY IN UK	80.00
08-DYSAN DISKS (6.00*35)	210.00
09-CPM HANDBOOK	10.00
10-50 BASIC EXERCISES (BOOK)	10.00
11-2000 SHEETS PAPER (BOX)	20.00
12-MAGIC CALC (MODELLER)	175.00
11-17 ITEMS ON DEAL TWO +++++	1205.00
(NOT INC VAT)	7245.00
DEAL FIVE *** 5995.00	**********

01-TELEVIDEO 64K RAM 7.3 MEG	4595.00
02-17 ITEMS ON DEAL FOUR	3830.00
(NOT INC VAT)	8425.00
DEAL SIX *** 6995.00	**********

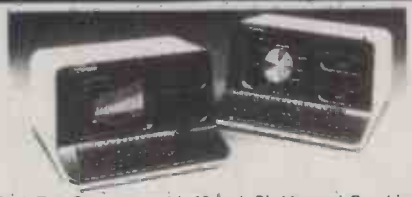
01-SUPERBRAIN 64K RAM/700K	2195.00
02-SUPERBRAIN 64K RAM/700K	2195.00
03-CORVUS 5.6 MEG & MUX/USER	2745.00
02-17 ITEMS ON DEAL FOUR	3830.00
(NOT INC VAT)	10965.00
DEAL SEVEN *** 8995.00	**********

(NOTE: The principle of this deal is that you pay (approximately) for hardware, warranty, consumables and 1 program. The rest is ***FREE***. You could make up your own package from our price list similarly.)

CALL ONLY BY PRIOR APPOINTMENT AT 55 BEDFORD COURT MANSIONS, BEDFORD AVENUE LONDON W C.1

G. W. COMPUTERS LTD.

SuperBrain users get exceptional performance for just a fraction of what they'd expect to pay. Standard SuperBrain features include: two double density mini-floppies with 350kbytes of disk storage, 32k of RAM memory (expandable to 64k) to handle even the most sophisticated programs, a CP/M® Disk Operating System with a high powered text editor, assembler, debugger and a disk formator. And, with SuperBrain's S-100 bus adaptor, you can add all the programming power you will ever need . . . almost any type of S-100 compatible bus accessory.
SuperBrain's CP/M operating system boasts an overwhelming amount of available software in BASIC, FORTRAN, COBOL, and APL. Whatever your application . . . General Ledger, Accounts Receivable, Payroll, Inventory of Word Processing, SuperBrain is tops in its class. And the SuperBrain QD boasts the same powerful performance but also features a double-sided drive system to render more than 700k bytes of disk storage and a full 64k of RAM. All standard!
Whatever model you choose, you'll appreciate the careful attention given to every engineering detail. A full ASCII keyboard with numeric pad and user-programmable function keys A non-glare, specially focused 12-inch CRT for sharp images everywhere on the screen. Twin Z-80 microprocessors to ensure efficient data transfer to auxiliary peripheral devices. Dual universal RS-232 communications ports for serial data transmission. And, a single board design to make servicing a snap!



Integrated Desk Top Computer with 12 inch Bit-Mapped Graphics or Character Display. 64Kb RAM, 4 MHz Z80A, ® Two Quad Capacity Floppy Disk Drives, Selectric Style 87 Key Keyboard, Business Graphics Software.

The North Star ADVANTAGE™ is an interactive integrated graphics computer supplying the single user witha balanced set of Business-Data, Word, or Scientific-Data processing capabilities along with both character and graphics output. ADVANTAGE is fully supported by North Star's wide range of System and Application Software.

The ADVANTAGE contains a 4MHz Z80A® CPU with 64Kb of 200 nsec Dynamic RAM (with parity) for program storage, a separate 20Kb 200 nsec RAM to drive the bit-mapped display, a 2Kb bootstrap PROM and an auxiliary Intel 8035 microprocessor to control the keyboard and floppy disks. The display can be operated as a 1920 (24 lines by 80 characters) character display or as a bit-mapped display (240x640 pixels), where each pixel is controlled by one bit in the 20Kb display RAM. The two integrated 5¼-Inch floppy disks are double-sided, double-density providing storage of 3600Kb per drive for a total of 720Kb. The n-key rollover Selectric style keyboard contains 49 standard typewriter keys, 9 symbol or control keys, a 14 key numeric/cursor control pad and 15 user programmable function keys.

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☆☆☆ BUS ☆☆☆

(BUSINESS EFFICIENCY)

WIDELY USED IN U.K./FRANCE/U.S.A. AND ENGLISH SPEAKING COUNTRIES FOR ITS OVERALL FLEXIBILITY AS A COMPLETE BUSINESS PACKAGE

INCLUDES INVENTORY, DATABASE MANAGEMENT, INVOICING, MAILING ADDRESSES, STATEMENTS, SALES/PURCHASE LEDGER WITH OR WITHOUT AUTO STOCK UPDATE AND DOUBLE ENTRY JOURNALS INCLUDING NOMINAL LEDGER; PLUS A'C RECEIVABLE AND PAYABLE MAKING AUTO BANK ENTRIES.

01=NAMES AND ADDRESSES	13=STATEMENTS
02=STOCK FILES	14=TAX REPORTS
03=OPEN SALES LEDGER	15=AGED ANALYSIS
04=OPEN PURCHASE LEDGER	16=MANAGEMENT ANALYSIS
05=GENERAL SALES LEDGER	17=CASHFLOW FORECAST
06=GENERAL PURCHASE LEDGER	18=PARAMETER SECTION
07=BANK UPDATE	19=DIARY REMINDER
08=USER DATABASE AREA	20=COMPUTER FUNCTIONS (+)
09=INVOICE CREATION	21=FILE MAINTENANCE
10=ORDER FILES	22=CALL OTHER PROGRAMS
11=TEXT FILES	23=AUTOMATIC DRIVE (+)
12=EMPLOYEE FILES	24=DISK SWAP/EXIT SYSTEM
WHICH OPTION	(LEVEL 8.00 @ 575.00)

++++++++ Super — Bus +++++++++ A new higher level of the above package. . . . has been reduced in size by 50 per cent to a single 15K basic program, making all file retrievals a matter of nanoseconds. Works under compustar for common data retrieval level 10.00. . . . . **** 975.00 ****

Database features are: . . . for any size record up to twenty fields file architectures can be designed with complete freedom over the linguistic conventions assigned to each field. The file then can store 32000 records which can be searched by the random access number (retrieved in less than one second) or 'key' random access on specified field or sequentially comparing for left field parts, field-inkeys, or parts of record, and then changed, printed, deleted, skipped.

Grama (Winter) Ltd./G. W. Computers Ltd., are the producers of this package which is unequalled for its level of total integration, linguistic flexibility and maximised disk/memory conservation.
Author Tony Winter (M.D.; B.A. LIT; B.A.HON.PHIL; and lecturer)

NOTE: the above menu options are subject to change without notice or obligation, the bus program 8.00 includes DBMS II if purchased at 675.00 and thus a number of program menus are available.

24 HOUR ANSWERPHONE-LEAVE ADDRESS FOR STANDARD INFORMATION DATA PACK

IMPORTANT!!! No hardware is any value without the software, and our software is unequalled. Buy a complete system and get most of the software free.

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SUPERBRAIN 320K	1695.00	NORTH STAR 700K	2495.00	OKI MICRO-82A	575.00
SUPERBRAIN 700K	2195.00	NORTH STAR 5.3M	3495.00	OKI MICRO-83	795.00
SUPERBRAIN 1500K	2595.00	TELEVIDEO 7.6M	4595.00	OKI MICRO-83A	850.00
COMPUSTAR 10 0K	1695.00	TELEVIDEO T'MNL	1195.00	EPSON MX80FT	475.00
COMPUSTAR 20 320K	2495.00	TELEVIDEO 700K	2395.00	EPSON MX100	675.00
COMPUSTAR 30 700K	2695.00	VTR MIRROR DUMP	695.00	TEXAS 810	1395.00
COMPUSTAR 40 1.5M	2995.00	7 STATION M'PLEX	695.00	SCRIPTA KSR	975.00
COMPUSTAR 10M DSK	3250.00	BUS ACCOUNTS 8.0	575.00	NEC 3350	1395.00
CORVUS 5.6M H'DSK	2250.00	DBMS II	575.00	NEC 5510	1795.00
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CORVUS 20M H'DSK	4250.00	QUME S/S FEEDER	750.00	QUME 9/45	1695.00
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MSORT & DSORT	75.00	LETTERIGHT	100.00	UTILITIES	150.00

Formats: (for Basic, DBMS II, = N'STAR & SUPERBRAIN 5".) . . (for super-calc = 8"; Zenith; Xerox; Apple; Vector. (for Magic Wand/Calc = N'Star & Superbrain)

Any of our computer terminals automatically include ***** FREE *****

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BISYNC-80/3780 and BISYNC-80/3270 are full function IBM 2780, 3780 and 3270 emulators for micro computers. BISYNC-80/3780 gives you a Remote Job Entry terminal for the price of a micro! BISYNC-80/3270 combines the local processing power of a micro with a sophisticated screen capability. Make your dumb terminal smart! MET/TTY will connect your micro to a Timesharing service in simple teletype emulation.

BISYNC-80/3780 **£445/£20**
BISYNC-80/3270 **£445/£20**
MET/TTY **£145/£20**

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REPORT WRITER You input the values. Report Writer will perform your calculations and produce a report with your headings, totals and summaries. **£70/£10**

GLECTOR General Ledger option in Selector III, requires Selector III and C BASIC II. **£125/£30**

NEWLY RELEASED SOFTWARE

INFO STAR from MICROPRO **TBA**

POINTS TO REMEMBER

- All software is Ex-Stock and available on standard 8" disks or 5" disks for Vector MZ, Superbrain, Dynabyte and NEC PC 8000.
- Prices shown as Software with manual/manual only.
- tml WORD-STAR is a trademark of Micropro.

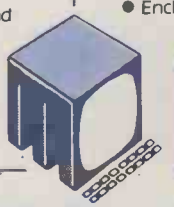
HOW TO ORDER

- State disk type and size ● Add 15% VAT
- Include £2 per Software item for Postage and Packing
- Enclose cheque/PO's payable to METROTECH

Mail to METROTECH MAIL ORDER, WATERLOO ROAD, UXBRIDGE, MIDDLESEX UB8 2YW

CREDIT CARDS— Telephone orders welcome: Tel: 0895 58111 Ext 265 or 206

TRADE ENQUIRIES WELCOMED



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- ★ Centronics standard interface
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INCLUDING *SOUND
*LOWER CASE *MODULATOR
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WITH FREE CASSETTE DECK

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8" for GP80A
2000 sheets

£12

9½" for EPSON & GP100A
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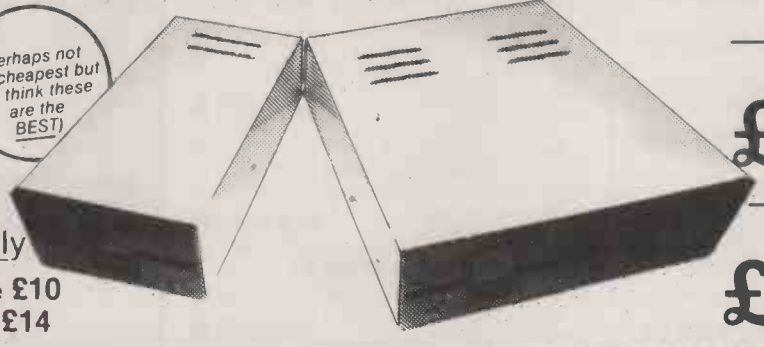
40 TRACK DISK DRIVES

COMPATIBLE WITH TANDY, GENIE, NASCOM, GEMINI, SUPER BRAIN, ETC.

The latest OLIVETTI Disk Drives fully cased and complete with Toroidal power supply

(Perhaps not the cheapest but we think these are the BEST)



DISK DRIVE Single drive **£10**
CABLES Dual drive **£14**

— SINGLE —
£179

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CARRIAGE: Orders over £100 ADD £6. Orders over £10 ADD £3. Orders under £10 ADD .50p

ACCESS. Access orders may be telephoned day or night, give full description of items, card number, name and address.

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I ENCLOSE CHEQUE FOR TOTAL £_____

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Whatever your micro needs just look at the choice, just look at the prices. Everything you could need, and more!

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Kaga 12" B/W Monitor inc. Cable	122.00
Kaga 12" Green Monitor inc. Cable	99.50
Philips 12" Amber Monitor inc. Cable	134.00
Kaga 14" Colour Monitor inc. Cable	249.00
Spare Perspex Screen for BMC Mk I & II/Kaga Mk I & II each	19.50

PRINTERS AND ACCESSORIES

	£
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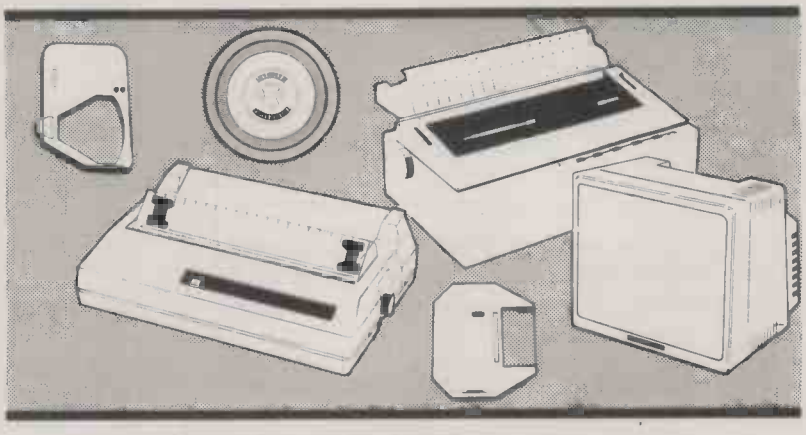

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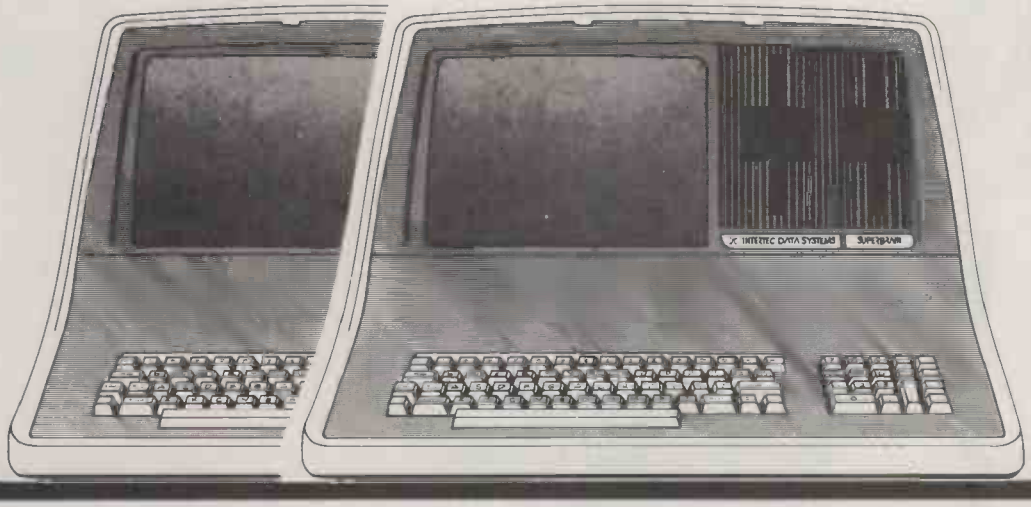

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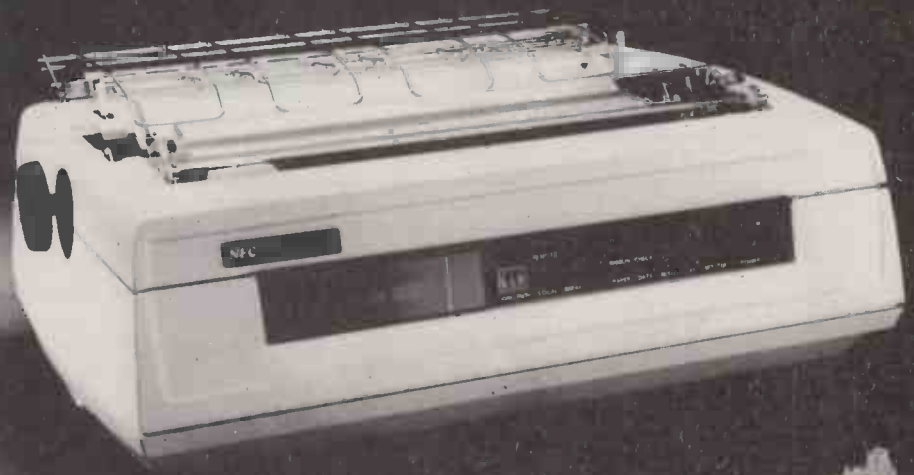

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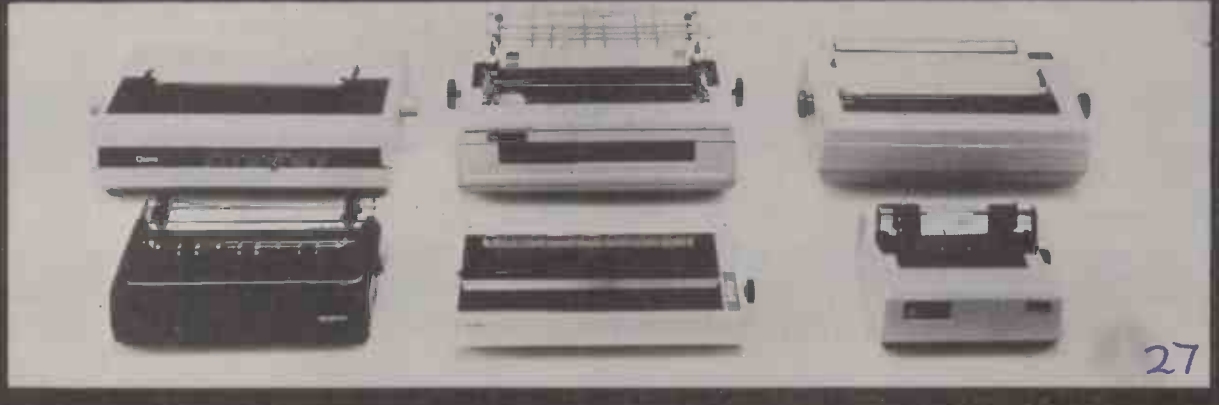

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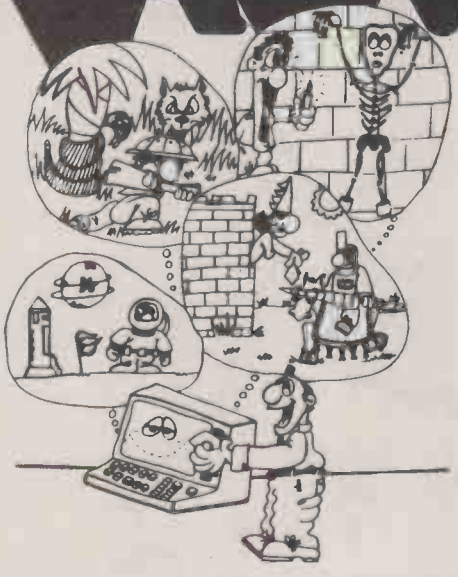

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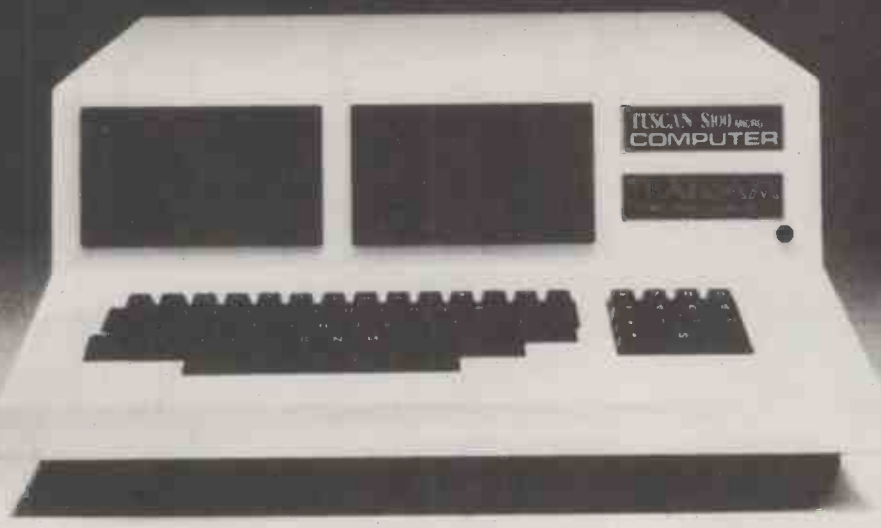

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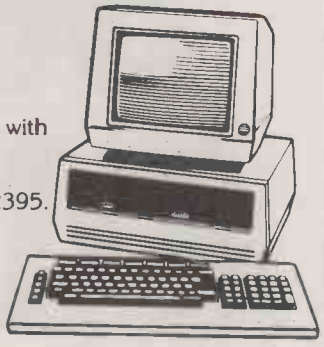

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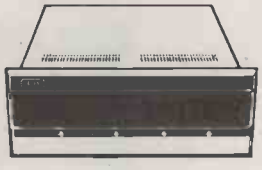

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Fussing over 16 bits

IT IS A SIGN of the confusion in our market that people who might well know better are falling over themselves in excitement with the new 16-bit machines — the Sirius, the IBM Personal Computer and Displaywriter and the Fortune. As David Powys-Lybbe's letter last month points out, at the moment a 16-bit machine is actually not as good as an eight-bit one because it has to run borrowed code. Like borrowed clothes, reach-me-down software is not necessarily the best. In fact the Z-80 code in which most CP/M software is written translates rather badly into 8086 code for the simple reason that the 16-bit processor lacks many of the powerful instructions that made the Z-80 popular in the first place.

And, as Powys-Lybbe points out, code translated direct from the eight-bit version will still be limited to 64K in the bigger machine. In fact, space available to the user may well be less on the 16-bit machine because the instructions of the 8086 are less compact and so take up more RAM.

It might be a good idea to think calmly about the advantages of 16-bit processors. The obvious advantage, that they deal with 16-bit chunks rather than eight bits, tends to evaporate on inspection. First, the Z-80 and other eight-bit machines do have 16-bit registers and can do some 16-bit arithmetic. But if fast arithmetic is your problem, you need one of the exotic, and fairly expensive, 16-bit arithmetic chips that do add, subtract, multiply and divide in hardware at something better than the speed of a big mainframe.

In real life more micros most of the time are doing nothing more exciting than comparing one string of text characters with another, one character at a time. You have told your Basic to Print and it runs down the table of commands asking itself whether you want to Get, Input, List, or whatever. In this sort of function the 16-bit processor works no faster than an eight-bit one because ASCII characters stay eight bits long whatever machine you use to maul them about. If you are stuck with 16 bits you spend half the time comparing eight bits of nothing with itself to produce a not very useful answer.

As micros become used to storing more and more data on hard disc, so micro operations inevitably become limited by the speed of the disc drives rather than the speed of the processor. From this point of view it does not matter whether your processor is eight-bit or 64. If the discs do not change, neither will the speed of your operations.

A realistic estimate of the increase in speed in 16-bit processor over eight bits would be between one and two — ranging between no change and double, with a bias towards the bottom end, depending on the frequency of disc operations. The one real advantage of the 16-bit machines is that they will address more than 64K of memory. Just how much depends on the machine, but for most of them it is more than anyone can afford to fill, for the moment at least.

However, addressing more memory is of little avail unless the software is rewritten to take advantage of the room. A Basic for a 16-bit machine has to be structured differently from an eight-bit Basic if it is to use the hardware properly. This calls for extra time and expense for the software houses doing rewrites, and — perhaps more worryingly for them — means that two quite different programs have to be maintained.

This is not to say that 16-bit software will not come, and that when it does it will not be better than the equivalent eight-bit packages. Already one sees a return to the "keyhole coding" of the early mainframes in an attempt to cram more program into 64K than God ever meant to be there. It will be a great relief for the more ambitious software houses to be able to take its corsets off and spread out into the freedom of a couple of hundred K of RAM. We ought to be seeing, for instance, a single package that provides the functions of database management, word processing and spreadsheet calculation all in one package, so it all works in the same way on the same data without even having to page program segments in and out.

Another compelling reason for more RAM is the demands of high-quality graphics. Very few people in the world are entirely happy with the alphabet as a means of expression. They would be much more at home with pictures, and a number of up-market software packages use pictures to help the user communicate with the machine. For instance, in the Smalltalk system being developed by Xerox in America. you point to a picture of an in-tray on your screen to see incoming documents, or to a drawing of a wastepaper basket to erase them from the file.

However, just as we are beginning to see a reasonable flowering of Z-80 software after the machines have been around for three or four years, two or three years from now we ought to begin to see some reasonably mature 16-bit software. Unfortunately for the 16-bit promoters, it is far from certain that the machines will be there to support the new offerings. The eight-bit machines were launched in reasonable numbers on sheer enthusiasm for computers in the abstract.

It seems to us that until new processors are so much more powerful than the old that they can run unconverted eight-bit software in an emulation mode at least as well as an eight-bit machine — equivalent to asking an interpreter to run as fast as a compiler — there will not be much sense in changing from eight-bit machines. That will not happen until there is a a 32-bit micro running at a 24MHz clock.

The latest tiny miracle, Sinclair's Spectrum, with its proposed 100K backing stores at £50 each — is a machine which could well sit on many a desk doing work for £200-odd that at the moment is done by gear that costs £2,000. If Sinclair's next launch is not a proper business machine for hundreds rather than thousands of pounds, then someone else's will be.

This drastic lowering of the price of hardware will rapidly bring down the cost of software. The standard price in the Sinclair, Vic, Atom market is about £15, and for that you can now buy packages like VisiCalc look-alikes which cost £150 on proper micros and £1,500 on minis. As time goes on, the huge returns which the mass market offers will attract software authors like moths, leaving the "serious" business micros of today stranded, rather as the minis are now. That too will militate against the 16-bit machines.

Finally, by way of a little light relief, here is how you really can tell whether a 16-bit processor is better than an eight-bit one, and if so by how much. The good news comes to us from Dino Moro Sanchez and Umberto Tosi writing in *AirCal Magazine* of March 1982. To them it is all very simple: they dismiss as ludicrously conservative the idea that a 16-bit machine might be only twice as fast as an eight-bit one. No, they delve deeper than that. They observe that a bit implies a multiplication by 2, so that a nine-bit machine must be twice as powerful as an eight-bit one and a 10-bit four times more so. By this reckoning, 16-bit machines must be 256 times as powerful as an eight-bit, and since it is often reckoned that an eight-bit machine is equivalent to about 1/20 of an IBM 370, a 16-bit machine must be worth at least 10 of those beasts.

Having solved that tricky question, Sanchez and Tosi turn their attention to the rival 16-bit processors. How can you distinguish between one and another? Which of them is the best? You are advised to provide yourself with an example of each chip: the 68000, the 8086, the Z-8000 and the 9900. Spread them on the table before you, then count the pins.

What then? Well, the one with the most pins must be the best.

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Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback—it is your chance to keep in touch.

Duncan in BCPL

FRANK DALE'S comparison between Forth and Pascal — Feedback, May 1982 — is a good illustration of the relative strengths of these very different languages. An experienced user of Forth should be able to generate small programs faster than a user of Pascal, but Pascal is easier to understand and maintain. So it is reasonable to use Forth in fairly small systems maintained by the author, while Pascal is more appropriate for larger systems.

Dale also demonstrates the compactness of Forth by comparison with Pascal, but it is not necessary to use Forth instead of a conventional structured language just to achieve compactness.

If Drunken Duncan is coded in BCPL instead of Pascal, the program can be structured in the same way and is as easy to understand. Yet the BCPL version compiles into 342 bytes of Cintcode compared with Frank Dale's 543 bytes in Forth and 876 bytes in Pascal P code.

John Richards,
RCP Ltd,
Blewbury,
Oxfordshire.

DAI users

TOGETHER WITH a few others I am trying to get a DAI users' group together in the U.K. There are not many of us so we really need each other to make the most of DAI's possibilities.

If other DAI users would like to contact me, stating the main areas in which they are interested, I will put them in contact with other members of the group whose interests coincide most nearly with their own.

Dave Atherton,
16 Douglas Street,
Atherton,
Manchester M29 9FB.

Basic editing

THE PROBLEMS experienced by R G Silson — Feedback, February 1982 — have caught my eye on several occasions. My own computer system allows me to perform full cursor editing of the Microsoft disc Basic on screen, including line numbers. Lines can be renumbered to repeat them throughout the program, and the text can be overtyped, opened up or closed for character insertion and deletion.

I can also edit and re-enter command lines to CP/M and certain other utilities which makes repetitive commands much easier to carry out. I can have several commands displayed down the screen, and they can be repeatedly entered simply by pressing the Edit key, moving the cursor to the line and pressing Return.

An optional screen paging mode is available during execution of commands like List and Type, and it is no longer necessary to "dive-bomb" Ctrl-S.

A single-key command will dump the contents of the screen to the printer from any of the screen formats available. The system will support a 128K virtual disc using two 64K RAM boards on pages 2 and 3. I also have the facility making single-key Command Line entry possible.

Some of these features are unique among CP/M systems and are largely dependent on the effectiveness or otherwise of the CBios supplied to interface the system hardware to CP/M. This in turn is often dependent on the motivation of the CBios author.

Silson raises several points about the Renum command. My improved Editing features remove some of these problems, but the rest can only be solved by modifications to Basic itself, and this is obviously something for Microsoft to consider.

With regard to the speed problem, it may be that the Z-80 is not run at 4MHz, or that the problems of interfacing the software or hardware introduce a speed loss due to some compromises. On my 64K Nascom/Gemini system — 350K per drive; duel density, running at 4MHz without wait states — Basic 80 is even faster than the Nascom ROM Basic, which has been among the leaders in the benchmark stakes. On my system the 24K Basic is loaded from a standing start within about four seconds of pressing Enter.

If you want a system for purely business purposes, by all means buy one of the nicely packaged, but difficult to expand and "taboo to touch" boxes that now abound. But look more carefully if you are interested in learning about all aspects of computing, with a system that can start small but can be expanded to professional standards easily and at

(continued on page 45)

Duncan in BCPL.

```
SECTION "DUNCAN"
GET "libhdr"    // standard definitions
MANIFEST
$( // cursor movement characters
   left = 8; right=24; up = 11; down = 10
   homeup = 29; clear = 31
   time   = 1000  // Delay constant
$)
GLOBAL
$( xlen:250; ylen:251; staggers:252
   seed:253
$)

LET rdn() = VALOF  // random number 0, 1 or 2
$( seed := seed*31421  + 6927
   RESULTIS ABS seed REM 3
$)

LET sleep() BE FOR I = 1 TO time LOOP

LET stagger() BE
$( LET i = rdn()
   SWITCHON i INTO
   $( CASE 0:  WRBIN( up)   ENDCASE
      CASE 2:  WRBIN( down)  ENDCASE
   $)
   xlen := xlen + i - 1
   i := rdn()
   SWITCHON i INTO
   $( CASE 0: FOR j=1 TO 4 DO WRBIN( left)   ENDCASE
      CASE 2: FOR j=1 TO 4 DO WRBIN( right)  ENDCASE
   $)
   ylen := ylen + i - 1
   staggers := staggers+1
$)

LET offgrid() = xlen!0 | xlen!16 | ylen!0 | ylen!16

LET START() BE                  // main entry point for BCPL
$( seed := 4999
   SELECTINPUT( FINDINPUT( "KEY:"))
        // to read one character at a time from the console
   $( WRBIN( homeup); WRBIN( clear)
      xlen := 8; ylen := 8; staggers := 0
      FOR I = 1 TO 8  DO WRBIN( down)
      FOR I = 1 TO 32 DO WRBIN( right)  // to centre of screen
      $( sleep()
         stagger()
      $) REPEATUNTIL offgrid()
      WRBIN( homeup); WRBIN( clear)
      WRITEF( "OFF GRID IN %N STAGGERS.*N", staggers)
          // *N is newline character, %N substitutes number
      WRITES( "*NANOTHER ONE ? ")
   $) REPEATWHILE RDCH() = 'Y'
$)
```

(continued from page 43)
reasonable cost. There are not many of them about, no matter what the advertisements claim.

C Bowden,
Stithians,
Cornwall.

WordStar on Apple

I HAVE RECENTLY purchased the WordStar word-processing system but have so far been unable to install it satisfactorily on my Apple II which is connected to a Centronics 737 by an Apple II parallel printer interface card A2B0002X. From the Printer Menu I selected "Any Teletype-like printer", and from the communications protocol menu I selected "none".

If I select the CP/M list device from the printer driver menu Wordstar appears to function properly and can print upper and lower case. Yet whenever I incorporate print-control characters in the text the printout is corrupted at the places where these print controls were inserted. If I select the parallel Centronics printer driver I have more problems.

- What is output port for printer?
- What is output status port for printer?
- What bits change at output status port when output port becomes ready to accept a character for output?
- What bits change from a 0 to a 1?
- What value should be output to the status port to "strobe printer" and inactivate "clear printer"?
- What value should be output to the status port to inactivate "strobe printer" and activate "clear printer"?
- What value should be output to the status port to inactivate "strobe printer" and inactivate "clear printer"?

The supplier has so far been unable to help me, so can anyone supply a solution to my problems?

Jack McLeish,
Edinburgh.

Pet 4016 bug

SOMETHING UNUSUAL happens to Rem statements containing capitals in the business mode on the Commodore 4016. Being an arrogant fellow I started my program with:

```
5 rem By R. J. Dowling
```

On listing, however, I read:

```
5 rem peeky backup.mid$.str$0wling
```

Can anyone explain this and suggest a way to avoid the problem or to put it to a practical use?

R J Dowling,
King's Lynn,
Norfolk.

Pet subroutines

IN HIS ARTICLE on Pet machine-code subroutines in the May issue of *Practical Computing* P H Richards implied that it is inevitable that machine language incorporated in Basic Rem statements would list on the screen as Basic keywords, producing some odd and long lines. But if instead of incorporating a RemRem structure at the start of the routine, you substitute Rem, then the following machine language will list merely as single-character graphics symbols, rather than Basic keywords.

As the first line of the program, enter:

```
0 rem"          (as many spaces as possible) "
```

After the machine code is entered, it will list in a tidy fashion. Any spaces left over at the end of the routine can be deleted, or a comment may be added to indicate the purpose of the accompanying code.

Under most circumstances this system allows the line to be edited directly from Basic without recourse to Tim, though this is not possible when part of the machine code is an ASCII 22 hex — a quote — or 0D, carriage return. These codes take the computer out of "quotes mode" back into the real world, and allow it to display the code as keywords again.

As long as the computer is still in "quote mode" the line may be renumbered or edited in the usual way. It is even possible to enter machine code direct from Basic if the hex code is translated into graphics characters first, and then put in the Rem.

Peter Wood,
Ampleforth College,
York.

Polynomial solutions

I WAS INTERESTED to read the useful article on solving polynomials by Daniel Zlatnik, in Open File, Z-80 Zodiac in the April issue, but certain limitations of the method described were not made clear. The method of bisection, where the interval between limits enclosing a root is halved at each iteration, has a rather slow convergence. More important, it is unsuitable for complex roots or where there is a double root or multiple root of even order.

Evaluation of a polynomial function in the form

```
DEF FNP(X)=A*X↑5 + B*X↑4 +
  C*X↑3 + D*X↑2 + E*X + F,
```

is often better done by the method of nested multiplication

```
(((A*X + B)*X + C)*X + D)*X +
  E)*X + F,
```

which requires fewer arithmetic operations, and is also quite simple to program.

Solving polynomials in general is not a trivial problem, and the method used must be chosen with care depending on the type and order. We use a small computer for simple molecular-orbital calulations in theoretical chemistry. We have developed programs for solving polynomials up to order 30 from a class whose members are known to have real roots within the range +/-3.

Even within this restricted range there are pitfalls; for example, higher-order polynomials necessarily have a high frequency of oscillation and it is not always easy to obtain convergence to all roots. Our most satisfactory method is to use a pair of programs. We start with a program which evaluates the polynomial over the whole range for a table of 20 equally spaced root values.

These 20 root values, which conveniently fit the screen, are displayed with the corresponding function values, together with stars to draw attention to a change of sign between any two consecutive function values. The program then allows any X value to be selected as a median value of a new narrower range, which is again displayed over 20 points in the same way. This procedure, which is like looking at the graph of the function under increasing "magnification" is continued until all the roots are located, and it may be continued to the limit of arithmetic precision of the Basic being used.

A second program is available, based on Newton's iterative method in which

$$X_n - F(X_n)/F'(X_n)$$

is a better approximation than X_n to the true root nearby.

We have also used Laguerre's formula as an approximation. This is

$$X_n - nF(X_n)/(F'(X_n) +/- (H(X_n))\uparrow 0.5$$

where $H(X_n)$ is given by

$$((n-1)\uparrow 2)*(F'(Xn))\uparrow 2 - n*(n-1)*F(Xn)*F''(Xn)$$

Laguerre's formula gives a faster convergence, but on the whole we find it less reliable.

A set of approximate roots obtained from the first program is input to the second one to obtain the most accurate values. The accuracy of the approximate roots has to be determined by trial and error, but it is quite easy to switch back to the first program if a root refuses to converge as desired.

E C Kirby,
Resource Use Institute,
Pitlochry,
Perthshire.

Arts and the micro

WE HAVE BEEN contracted to write a book that will look at the actual and potential impact of microelectronics on the humanities in education. We believe that the computer has a significant contribution to offer to the teacher in this field and, conversely, teachers in the humanities have a key role to play in developing the vital understanding of the social consequencies of rapid technological change.

We would very much like to hear from teachers already developing materials along these lines. We are anxious, too, to hear of programs which are integrated into the work of humanities classrooms and make use of the imaginative and interactive potential of the microcomputer. Please write to us through *Practical Computing*.

Anthony Adams, Esmor Jones,
Cambridge.

Show heads for the North

FOLLOWING the success of *Practical Computing's* own exhibition — The Computer Fair — a similar event is to be held in the north of England towards the end of November.

Called The Northern Computer Fair, the exhibition will take place at Bellevue, Manchester on November 25-28. Like its counterpart in London, the exhibition will provide an ideal showcase for companies wishing to demonstrate to a fast-expanding and increasingly well-informed audience all aspects of personal computing from home computers to business systems.

The interest being generated by personal computers can surprise even those who have been in the business for some years. The Computer Fair held at Earls Court during the last weekend in April was unquestionably Britain's biggest-ever personal computer exhibition.

More than 38,000 people visited the show to see a range of equipment extending from the Sinclair ZX-81 up to the IBM Personal Computer which was featured on the KGB Micros stand. Software from games to business applications packages for a wide variety of computers was demonstrated on a large number of stands.

Clive Sinclair chose the Computer Fair as the exhibition at which to launch the ZX Spectrum computer — see review on page 66 — and it was inevitably the star of the show. It attracted crowds four and five deep to the Sinclair Research stand throughout the exhibition.

Other popular aspects of the Computer Fair were the ZX-81 Village which attracted devotees of the Sinclair home computer in their thousands, and Club Avenue, a series of stands manned by user groups representing the best-known personal computers — Apple, Pet, Tandy TRS-80 and the BBC Micro to name only a few.

A purpose-built arena was the focal point for the Micromouse contest. The British finals of this event where held at the Computer Fair with the winner, Alan Dibley, of Cheddar, receiving an all-expenses-paid trip, generously provided by Elbit Data Systems, to the European finals in Haifa, Israel in September. A report on the Micromouse contest appears on page 159 of this issue.

Next year the Computer Fair will again be held at Earls Court, London, on June 16-19, 1983.

Crowds besieged the stands at Earls Court's Computer Fair — Britain's biggest-ever personal computer exhibition.

Card that turns Pets on to CP/M

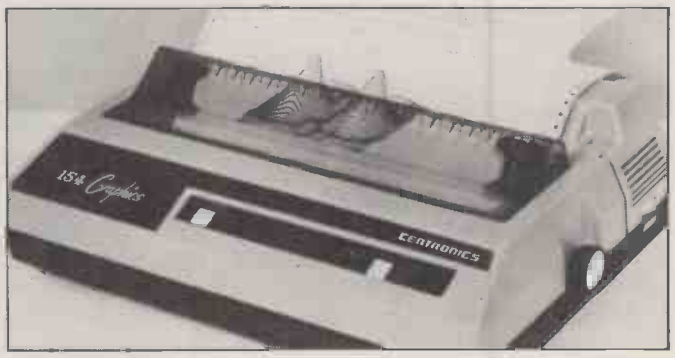
CP/MAKER is a card that fits inside the case of a Commodore Pet computer and converts it into a powerful 64K CP/M machine. The card is totally self-contained and can be fitted in a couple of minutes. When the card has been fitted the Pet looks just like any other, but with the power turned on, the difference is clear. After a simple command is executed the machine has access to a full 64K of CP/M memory and 32K of ordinary CBM ROM.

The board contains a Z-80A, and an extra 6502 chip because as Gabor Weiner, managing director of Vector International pointed out, "It would be disastrous if someone damaged their processor". The two processors may run simultaneously at full speed, and any software written under CP/M 2.2 will run.

The CP/M maker has an upload/download capability which enables it to transmit and receive any type of CP/M file from another CP/M computer. It comes as an option complete with RS-232 interface and the BSTAM communications protocol from Lifeboat associates. The software provides error detection, automatic retries and handshaking; the CP/M wildcard file names are also supported.

CP/Maker is supplied in Europe by Vector International of Belgium. Vector is already the European supplier for Digital Research products, the originator of CP/M, and has now opened an office in Britain at 51/53 The Pantiles, Tunbridge Wells, Kent TN2 5TH.

This is the new model 154 dot-matrix graphics printer from Centronics. It combines all the standard features of a 132-column industrial-grade computer printer, together with pin-addressable graphics. The machine uses a high-quality 11-by-eight dot matrix, which can print in seven international character sets. The 154 can print at 120 cps with bi-directional and logic-seeking printing. Its potential market includes CAD and CAM applications as well as business analysis and data processing. The model 154 costs £824 and will be available from most existing dealers. For further information about the printer contact Centronics, Victoria Way, Burgess Hill, Sussex. Telephone: (04446) 45011.



Cartridge memory

YOU CAN now keep a cupboard full of 10Mbyte cartridges at £99 a go, while your Apple or S-100 system accesses the 8in. removable mini-Winchester cartridge currently mounted in X-Data's new drive. Called the Kitten, the drive costs around £4,000 with the appropriate interface and is also available for the TRS-80, Altos, Pet, LSI-11 and IBM Personal Computer. Details from X-Data at Marish Wharf, St Mary's Road, Langley, Slough, Berkshire SL4 1HE. Telephone: Slough (0753) 49117.

Genie micro family is extended

HARD ON THE HEELS of Genies I and II comes the new Eaca Genie III. Unlike its predecessors, the new model is a fully expanded and integrated microcomputer system. It comes complete with 64K of RAM, a built-in screen, dual disc drives with a double-density storage facility and a full-sized keyboard with numeric keys.

The Genie III is remarkable in that it is capable of running an extremely large number of programs thanks to the two operating systems that are implemented on it. Of course, no microcomputer would be complete if it could not run CP/M, but the Genie III can also run programs written in the popular level II Basic — as used by Tandy TRS-80 computers.

The basic Genie III computer costs £1,600; complete systems with all the peripherals and accessories weigh in at around £3,500. Although the principal users of the Genie III will be the proverbial small businesses, the Genie might also appeal to the well-heeled hobbyist.

The Genie range is imported by Lowe Electronics, Chesterfield Road, Matlock, Derbyshire. Telephone: (0629) 2430.

Software hiring scheme

FROM JULY 1 Apple users will be able to rent software on a short-term basis when the Software Rental Bank is launched by software vendors Apple Orchard. Other machines will follow the Apple in quick succession, starting with the Horizon, Superbrain, Cromenco, ACT Sirius and IBM Personal Computer.

Packages will be available for periods of seven to 28 days for a typical cost of 20 percent of the retail price to Bank members. Membership costs £30 which allows a seven-day rental period, £70 for a 14-day rental period, or £500 for a 28-day rental period and a halved rental charge.

But what is to stop Bank members simply copying the software before returning it for an illicit but effective 80 percent price cut? Apple Orchard is the company which supplies Copy II plus, "an advanced bit copier which can defeat nearly every protection system now in use" according to a recent advert. Surely software suppliers will be hostile to the whole idea.

Yet, surprisingly, VisiCalc distributor ACT Microsoft is among the first suppliers associated with the Rental Bank scheme, as is Apple Computer (U.K.), system vendor and distributor of Apple Special Delivery Software range.

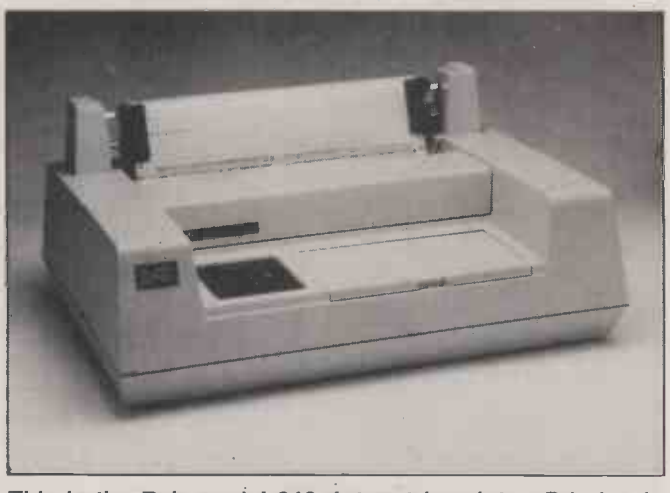
Clearly a lot of hard thinking has been going on about the balance of risk and advantage to be gained by adopting this means of exposing the merchandise to a possibly shoplifting-inclined public. Apple Orchard's John Chesney, just off to America to line up more software for the Bank, seemed happy to discuss all these points. "Rental will only be to signed up members of the Software Rental Bank. Once in the scheme the user is contractually bound by a membership agreement which specifically excludes improper copying, and goes beyond this to also bind the member to observe all the conditions imposed by the original software supplier. If this is violated then the Software Rental Bank will terminate the users membership".

When pressed Chesney conceded that in some circumstances he could imagine that they might want to go further and take legal action in conjunction with a supplier, but he did not expect they would have to. "Aside from the technical barriers to copying posed by the dongles and software-protection methods used with some products, we have taken the view that the kind of users of serious business packages we will get will not want to copy in an improper way. And it is clear that our suppliers take a similar view".

Software suppliers stand to gain most if members buy after a week or two's trial. They also gain from the packages John Chesney has out on rental as these are all purchased by the Bank on standard trade terms. They only lose out if members copy illicitly.

The suppliers risk little by giving it a whirl, as they can see both what their sales to the Bank are, and what their sales onward to Bank members are, so they can draw their own conclusions about the extent of illicit copying.

The Software Rental Bank can be contacted at 58 North Street, Leighton Buzzard, Bedfordshire LU7 7EN. Telephone: Luton (0908) 53491.



This is the Rair model 840 dot-matrix printer. Printing is fast, at 75 characters per second, using optimised bi-directional printing. The standard density is 10 characters per inch on-line and six lines per inch. Options are available for other sizes.

The Rair 840 can be supplied in a KSR form, with keyboard, or as a Demand printer with tractors and a 2K Fifo buffer. The basic model costs £720 and the demand package £895. Rair Limited, 6-9 Upper St Martin's Lane, London W1. Telephone: 01-836 6921.

DEC takes the plunge

DIGITAL EQUIPMENT CORPORATION, currently number one in the minicomputer market, has made the long-awaited move into the personal-computer field with four new systems. At the bottom end is the Rainbow 100, a dual-processor machine using an eight-bit Z-80 and a 16-bit 8088, and capable of running either CP/M or CP/M-86 programs. What is more, the user does not have to know which they are using, as the DEC CPM-86/80 operating system determines automatically which processor to use.

The Rainbow 100 has a low-profile keyboard, compact video monitor, a dual 5.25in. floppy-disc unit giving a total of 800K on-line storage, and 64K RAM expandable to 256K. The price is £2,200 to £2,400 in the U.K. and it is scheduled to be available from October.

DEC's answer to the quandary of whether to opt for an eight- or 16-bit machine at the lower end is to use both. CP/M may not be the ideal personal-computer operating system but it is where the users are and DEC clearly intends to get them on to its kit. In the longer term it may function as a migration tool for DEC to take users into models further up the range.

The Decmate II is Digital's low-end word-processing offering. It is built around the custom-designed 6120 microprocessor which has a 12-bit word length. Digital has a long line of word-processing systems built around a 12-bit processor architecture so this is not as surprising as it might seem.

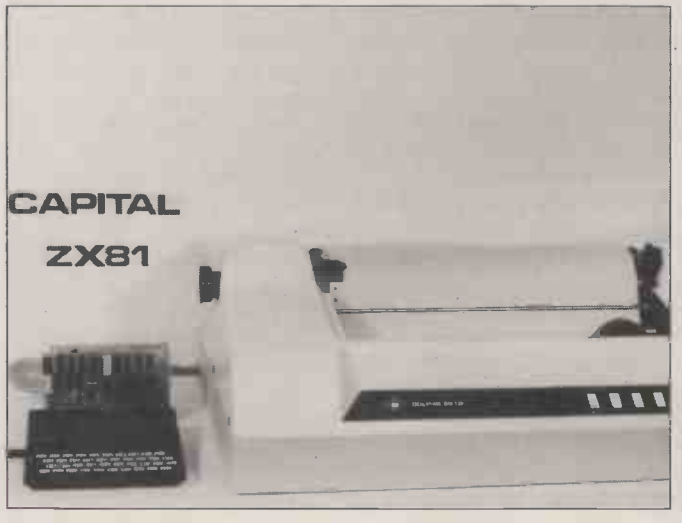
DEC will be able to run existing Decmate I software on the new system which comes with the same screen, discs and keyboard and system box as the Rainbow 100. With 96K RAM the system is priced at £2,400 to £2,600 and should be available from January 1983 in the U.K. Three new DEC printers will be available to go with it and there is a CP/M option.

Top of the range are the Professional 325 and 350. Both use the same F11 multi-chip set as the PDP-11/23 and come with 256K of RAM. The keyboard, screen and discs are the same as for the other new DEC personal computers. The system box on the Professional 325 is also the same, while the Professional 350 is larger to enable it to contain a 5.25in. 5Mbyte Winchester disc. The operating system P/OS is a derivative of RSX, and provides true multi-tasking facilities.

The Professional 325 is priced at £2,500 to £2,700, the Professional 350 at £5,400 to £5,600 with hard disc. DEC is throwing in the first 12 months' maintenance free on all four new systems in an effort to steal the march on its competitors.

The ergonomic standard of the units is very high, the keyboard in particular being designed to appeal to the serious office user. The video monitor is exceptionally small for its screen size, and the system box containing the floppy discs can be mounted horizontally or vertically to make it easy to put it out of the way or built it into the desk.

For details contact DEC at Digital Park, PO Box 110, Reading, Berkshire, RG2 0TR. Telephone: Reading (0734) 868711.



A Sinclair ZX-81 dwarfed by a full-size printer makes a bizarre picture, but if you have access to a decent printer at your work or college the obvious thing to do is to use it. Hooking it up has always been the problem, but now Capital Computers has produced a card which should work with any common printer or Modem. It provides the ZX-81 with an RS-232. Details from Capital Computers, 1 Branch Road, Park Street, St Albans, Hertfordshire. Telephone: (0727) 72917.

Program survey

WHAT STEPS are being taken by the people who write or supply software for a living to prevent improper copying? The Science and Engineering Research Council is funding a survey into practices and attitudes within the industry to the various legal and technical approaches possible.

The survey is being conducted by Simon Elson, who is also secretary of the new British Computer Society specialist group on the technology of software protection. The group is principally concerned with investigating technical as opposed to legal methods of protection, but for this survey he would be happy to hear microcomputer users' views on both approaches.

For a copy of his questionnaire contact him at the Technology Policy Unit, University of Aston at Birmingham, Costa Green, Birmingham B4 7ET. Telephone: 021-359 3611.

Plug-in board for Sinclair

THE GROUND CONTROL 16K RAM and I/O board is designed to be used with the ZX-81, but is easily adapted for use with other Z-80 micros. The board gives the user 16K of dynamic RAM together with the ability to interface to a wide variety of peripherals. The I/O is memory mapped and controlled by various Peeks and Pokes, or even machine code for faster applications.

The board simply plugs in to the ZX-81 and is connected to its own power supply. There are two 14-pin DIL sockets for connection to the outside world.

The unit is available built and tested and with power supply for £53. A version without the need for a separate power supply is available for £47.

Ground Control is at Alfreda Avenue, Hullbridge, Essex SS5 6LT. Telephone: Southend-on-Sea (0702) 230324.

Torch to make light of communications

THE TORCH computer is the business version of the BBC Micro with a powerful technical specification, especially in the area of communications. There are two on-board processors, a Z-80A running at 4MHz with 64K of RAM and a 4K bootstrap ROM, plus a 6502 running at 2MHz with 32K of RAM and 48K of ROM containing the machine operating system, a BBC Basic interpreter and communications software.

The display is a 12in. colour monitor — though monochrome is also available — which in the standard mode displays 80 by 25 characters. In addition there are a number of higher-resolution modes. Screen handling and graphics are all handled by the peripheral processor.

Among its powerful communication options there is the Torchnet for local networking with other Torch computers, an inbuilt Modem for connection to telephone and Telex lines, and a software-selectable baud rate. The communication modes are as follows: Torch to Telex using the Tele Torch emulation software; Torch to Torch using Torchnet; Torch to any other computer using Torchtalk software; Torch to mainframe using Torchterm; and Torch to viewdata systems using Torchtel.

Communications can be handled automatically without interruption of the applications programs running on the Z-80. Dialling is automatic and messages can be sent at any time, even when there is no-one in the office. An additional feature is that the Torch will keep dialling until the message has been successfully transmitted.

The interfaces allow connection to a Centronics-type printer or an RS-232 serial port. There are, in addition, four 12-bit analogue-to-digital converters. The keyboard is an expanded QWERTY type with a numeric pad and 16 user-definable keys. There is also a double disc unit.

Internally there is a sound generator and loudspeaker capable of producing three independent channels of sound over a three-octave range with level control and envelope shaping. There is also an advanced speech-synthesis unit, using phoneme encoding to produce realistic speech.

All Torch systems come complete with a secretary's aid program, a version of BBC Basic, communications software and the CPN operating system. The model A Torch costs £2,450 and the model E, with a 10Mbyte hard disc costs £4,950.

Torch Computers, Abberley House, Great Shelford, Cambridge. Telephone: Cambridge (0223) 841000.

Schoolboys try for ZX-81 adaptor award

TWO DUTCH SCHOOLBOYS were among the many entrants from as far afield as Yugoslavia and the United States who tilted for the £1,000 prize offered by Prestel to find an adaptor for the ZX-81. The object of the contest was to design and build a device which is capable of downloading programs from Prestel to a standard Sinclair ZX-81.

Our picture shows Marco van Gent (left) and Ari Schot, who travelled to London from their home in Leiden, Holland to make their presentation to the judges at Prestel headquarters. With them is the eventual winner of the contest, Barry Schofield of Lion TV London, who shares the prize with Martochoice Viewdata.

Schofield, whose design is not yet complete but which will eventually, he says, interface with other microcomputers including those supporting CP/M, may enlist the two Dutchmen to help him out with the software.

Meanwhile the other prizewinner, Martochoice, has been offered space on *Practical Computing's* own Prestel pages and will be publishing CET-formatted programs for the ZX-81.

Nascom releases Pascal compiler

NASCOM MICROCOMPUTERS has released a Pascal compiler, available in either tape or EPROM form, comprising a complete 12K language system. The components of the system are a run-time package of 4.5K, a 0.5K control program and a 1.5K on-screen editor, as well as a 5.5K compiler.

The compiler itself is of the one-pass type, which directly produces Z-80 machine code. Compilation is at an extremely fast 2,000 lines per minute, and the code produced will run programs at a speed between three and 20 times as fast as equivalent Basic programs.

The EPROM version comes on six 2716 EPROMs together with instructions for fitting them into the Nascom main PCB. Documentation is in the form of two manuals: a 17-page operating manual and a programming manual of 40 pages.

Nascom Pascal is distributed by Lucus Logic Limited, Welton Road, Wedgnock Industrial Estate, Warwick CV34 5PZ. Telephone: Warwick (0926) 497733.

Stack board enhances Vic-20 memory

THE STACK STOREBOARD is a printed-circuit board which plugs into the Vic-20. It is socketed to accept 27K of RAM, expanding the memory of the Vic to 32K, the maximum addressable. The board comes in a neat case which fits into the Vic at the same level, thus eliminating the memory wobble which is a common problem with some micros.

The Storeboard comes with 3K of RAM, which gives the Vic high-resolution graphics. No extra power supply is required to use the unit, and other cartridges may still be used by hanging them on the expansion socket on the rear of the port. Games ROMs, or any of the Vickit series of ROMs can be plugged into the board, as can extra RAM as and when conditions dictate.

In addition the four-slot motherboard from Stack has been developed to enable the user to use up to four cartridges. These are switch selected, allowing any one, two, three or all four cartridges to be used at the same time.

The Stack Storeboard with 3K costs £49 plus VAT, and the Stack 8K RAM pack costs £29, plus VAT; the motherboard costs £24.99 plus VAT.

All Stack products are available from Vic dealers, or from Stack, 290-298 Derby Road, Bootle, Liverpool. Telephone: 051-933 5511.

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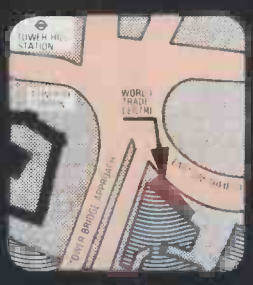

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Commodore's arsenal

We take a look at the plethora of new products just announced by Commodore.

THE LAST YEAR has seen an explosion in the choice of small computers available. Already we have seen the BBC Microcomputer, Sinclair's ZX Spectrum and the MZ-80A from Sharp. Added to this is the entry of the larger more established big league into the micro sector of the market. IBM, ICL, Digital, and Burroughs have all launched micros lately.

So it is with some interest that we take a sneak preview of the new machines from Commodore. Not so long ago Commodore was the biggest seller of micros in Britain. Just whether it can maintain momentum as the competition hots up remains to be seen, but the company's new range of computers clearly aims to do something about it.

In total, Commodore is adding six new computers to the range, to make a full complement of nine machines:

Vic-10, also known as the Max in the United States, is the machine that will compete with the Spectrum. Costing about £100, the Vic-10 will have sound, and full-colour graphics on a 320-by-200 pixel screen. On board will be a mere 2K of RAM. The graphics are promised to be "of the 3-D variety", whatever that means. A range of easy-to-use interfaces will be available, and the machine is to be sold as a three-in-one video game/home computer/music synthesiser. It will be available at the end of 1982.

Vic-30 is due to be launched in January 1983 to sell at around £250. It will have colour and sound similar to the Vic-10, 16K RAM and 20K ROM to carry the Basic and operating system. It will have the same "3-D graphics" as the Vic-10.

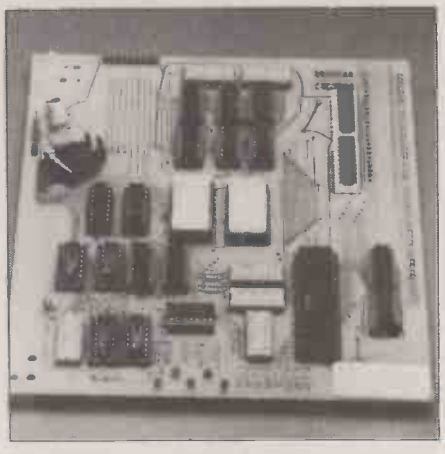
Commodore 64 is promised for October 1982 at a price of £450. Its specification is as for the Vic-30 but with 64K RAM and serial and parallel ports. There will be room for a Z-80 CP/M card, which is scheduled for some unspecified future date — illustrated above (right).

Commodore 510 will appear in September 1982 at a price of £695. It will have all the Vic-30's features with 64K to 256K RAM and the Z-80 CP/M slot — illustrated above (centre).

Commodore 710 is the mystery machine. Commodore will only say that it will cost £995 when it appears in September 1982.

Commodore 720, also due September 1982, has an 80-by-25 integral screen, two floppy-disc drives, 128K to 256K RAM and the CP/M board slot. It includes the Vic music-synthesis and sound facilities and is priced at £1,595.

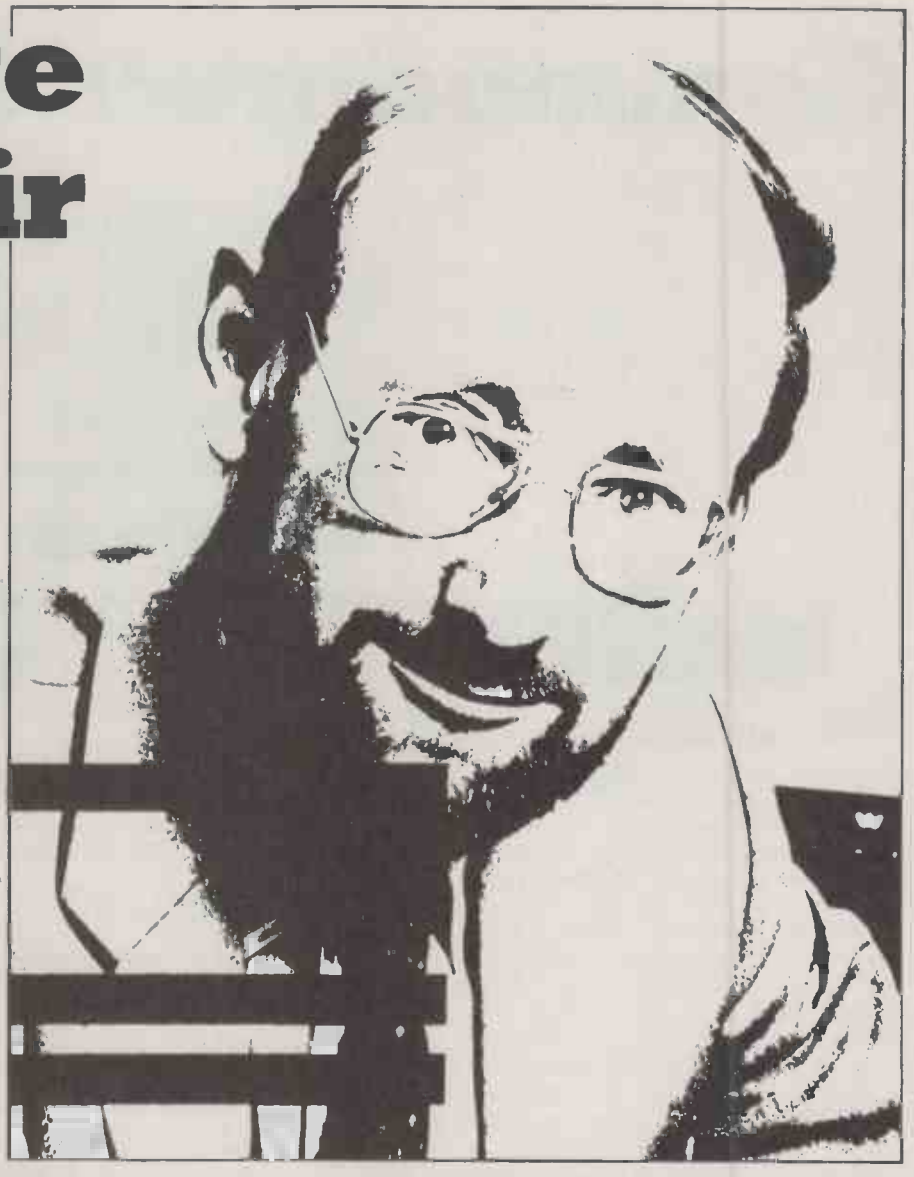
In addition there are to be three more disc drives, a new Diablo-based printer, a networking system called Keynet, as well as the Vic networking system.



The Keynet printed-circuit board.

The Commodore 720 computer is the top of the new range of micros.

Clive Sinclair



More people have heard of Clive Sinclair than of any other individual connected with computing. He talked to Martin Hayman about his past and present ventures, and plans for the future.

FOR MANY users of computers the systems giants do not exist, or at best are some shadowy presence at the edge of their vision. For them, Sinclair's name is synonymous with computers.

Asked to define briefly the nature of his success, his firm's pre-eminence in this fastest-moving of all businesses, Clive Sinclair — "Uncle" to many of those who would not claim even a nodding acquaintance with the recluse of Cambridge — responds with the idea of "advanced design".

Yet is advanced design an assurance of success? Sinclair certainly holds to it almost as an item of faith, a personal creed. Without his advanced design he would be nothing; with it he can aspire to king. Did he fear, for example, that as the microcomputer market attracted the industry behemoths with their huge resources of capital and research, and their vast production facilities, that his flexible but centralised outfit would be crushed by the onrush of capital seeking a down-market whitewash? No fears.

Creative electronics

Sinclair's belief in advanced design, and in particular in the ability of his own people to maintain the level of creative electronics design to keep him one or more jumps ahead of the would-be competition, is like a shield of righteousness: almost as if he had God on his side against the big battalions.

I suggested that this approach was almost the exact opposite to IBM's, yet sooner or later he would confront IBM in the personal-computer market-place. How would his ideas on elegance fare then? Did he know better than IBM? Did he, indeed, relish the fight?

"IBM is a fair competitor which has its views on the market-place as we have ours, and which of us succeeds in whichever market will be the one that does the better job. That is fair and straightforward. I do not relish the fight — nothing makes life more complicated than competitors — but I do not mind it. I think IBM is at a tremendous disadvantage because of its size. It makes it harder for them to react swiftly but there is the tremendous advantage of their experience and technical base.

"But in any one-for-one confrontation, as the phrase goes, we would win. I think we are better. First of all, where do they have their great strengths? Let's say marketing. In order to give ourselves that sort of strength we have allied ourselves with Timex which with 70,000 consumer outlets obviously has greater consumer strength than IBM in America.

"Then if you take our machine — the Spectrum — apart and theirs, you will see that theirs is a very old technology. On the outside the IBM Personal Computer may look elegant but inside it is board after board after board of chips. The cost of making it must be astronomical. It has been rushed through because the microcomputing craze has caught them unawares". Could it really be the case that IBM had not foreseen the new wave, I asked? Was its design not rather a different, perhaps more conservatively specified approach?

"No — open one up. It is unbelievable. They have a board about this big — the size of a large coffee-table book — with God knows how many chips on it, it must be 100, and that is just to do colour. We do it on one chip. It is the best they can do in the time available to them. That is always the case — big companies do not make the innovative steps, it is just not the way things work.

New generation

"In the same way the big motor-car companies will not be the leaders in electric cars, just as the big yacht companies of the past were not the people that built the steamers, just as the great train people were not the people that made the cars, just as they in turn were not the people who built the planes. Every time there is a new technology, a new generation of companies comes along".

And what about Sinclair Research?

Could he not foresee a time when Sinclair itself would be established, would become conservative and would be tripped up by the onrush of yet another new technology? "Yes, it will. We have no ability to prevent that; it will happen eventually — it is unavoidable. But we might be able to maintain our position at the leading edge indefinitely if we continue with our present policy of not being a big manufacturer or bulk distributor".

Commercial sense

To some very large extent, Clive Sinclair identifies with his own products. He brings you neatly up to date and then gives you a tantalising glimpse into the future: "Can't give any precise details but the worldwide patents are being filed". On the guided tour he may shaft a competitor or two, which is all good commercial sense and helps to popularise his own cause and sell his own products. So why exactly does he make computers?

"I make computers because they are a good market, and they are interesting to design. I don't feel bad about making them, or selling them for money or anything, there is a demand for them and they do no harm; but I don't think they are going to save the world".

Sinclair spends a great deal of his time simply thinking about the future, and the products which will answer the public's desires in three or more years time. One refreshing characteristic in a business where a little knowledge is often spread painfully thin, is that Sinclair is never afraid to say "I don't know anything about it".

In person, of course, he cuts the figure of everyone's favourite boffin: the pale skin, almost translucent yet with a rosy tinge; the high, domed forehead with its monkish rim of crisp, light-ginger hair: the pale, clear, steady eyes behind pebbly glasses. At the press conference to launch the Spectrum he spoke as Polonius prescribes; briefly, to the point and wittily, as the flashguns exploded around him.

His facility in public speaking is gained from practice: he is often invited to lecture on the computer business. A face-to-face conversation banishes any suspicions of self-conscious boffinry. His Chelsea apartment is cool, clear and uncluttered, and free of electronic machines except for a small Japanese cassette stereo. His suit and shirt, like everything else in sight, are expensive and understated. He speaks clearly and promptly and rarely evinces the flippancy to which others in his position might feel themselves entitled.

Two characteristics of Sinclair's products stand out when one looks at the history of Sinclair Radionics and Sinclair Research: their smallness and the original use to which chips have been put, sometimes working outside their intended purpose to create a new and unforeseen design concept. Sinclair says that smallness was never an end which was pursued for its own sake: it is a function of the need for elegant solutions to existing design problems. "I just like efficiency in design in whatever form".

Did he equate miniaturisation with elegance? "Not quite — in fact sometimes not at all. To miniaturise some things might be inelegant, but it is certainly inelegant to make things larger than they functionally need to be, assuming there is not some other benefit in making it larger. Once or twice we have made things deliberately small, like the radio kit. That was just a gimmick, to make it an exciting thing for people to build so that they could say it was the tiniest radio in the world".

Yet many people — for example, those with a desire to use a computer in the home rather than a need to use one in a professional environment — respond to smallness and may be prepared to make some corresponding sacrifices in outright performance. In an increasingly cramped and miniaturising age smallness is sexy, and for the manufacturer it can make the difference between sale and no sale.

Anyone who has ever used a ZX-81 knows that the first line of the display keels over; it does so because the design of the four chips was pared to the bone. In the domestic market, functionality can encompass a certain amount of corner-cutting if there is a countervailing trade-off in space utilisation, convenience and price.

Smallish is beautiful

Cynics might observe that in this context elegance may be little more than a self-serving concept fitted up to justify under-specification. Yet in most important respects Sinclair's current machines do work; they are not small merely in order to make them cheap. "If you take the current computer — the Spectrum — that is compact", says Sinclair. "If you made it any larger it would simply be more expensive. There would be no contra-benefit, so elegant design has led to a very compact shape compared with its competitors, not because we wanted it to be tiny. On the contrary — if we had wanted to make it really tiny we could have made it, I suppose, the size of a cigarette packet.

"But that would not have been functional, because the keyboard would not be usable. The Spectrum sacrifices nothing to size. The keyboard is exactly the same spacing and pitch as an IBM, which is why we went for that size. If we went down to the size of a cigarette packet it would not be cheaper, it would be more expensive. That size is optimum".

The keyboard is one area of the Spectrum's design which Clive Sinclair took an active part in specifying. Sinclair drew up the original specification of the Spectrum a mere year before they started rolling off the lines; and then delegated most of the production design, with the exception of the keyboard's design and specification and some suggestions on how to reduce the number of chips. His initial work was done with an engineer and an industrial designer as a three-man team.

What about reliability? Did the drive towards elegance ever militate against professional standards of reliability? It has been suggested that Sinclair effectively uses his public as guinea-pigs: many are the tales of returns not dealt with for weeks on end. "It's true that in the early days commercial pressures and lack of design experience led to a lack of reliability: 10 or 15 years ago we did not know how to design for reliability. Now we know very well — perhaps better than anyone. But it has been a long lesson to learn".

"Computers do no harm — but I don't think they are going to save the world"

What about all the ZX-81 returns? It is a calumny which Clive Sinclair rebuts heatedly: "That is absolutely not the case. We have records going back to the very first ZX-80s we produced. We have a lower rate of failure on our computers than anybody else in the world, and the reason for that is that we do everything to keep the quality right. The ZX-81 production line is a miracle of efficiency; after all, one is made every 10 seconds. They go through the most amazing quality control. Also we have a far lower component count than anyone else. We have only four chips where everyone else has 40".

Sinclair has plenty of experience in selecting chips. Many of his designs have displayed original and unconventional uses of components. He is self-educated in electronics and when he left school — the last of more than a dozen he attended — in 1958 decided not to go to university "because most of them offered only electronic engineering and I had no desire for such a broadly-based course."

By his own account, it appears he could have taken up any of a variety of careers: his first love was, and remains, mathematics: "I was very good at maths, if I may say so modestly". He had a strong interest in English, as evinced by the fact that his first few jobs were as a technical writer. By the time he married his interests in electronics — into which, he says, he was "diverted" from maths — and English were put to work in running

(continued on next page)

(continued from previous page)
a small electronics publishing concern. In 1962 he had already written 17 books.

Sinclair found the work comparatively undemanding and started to turn his theoretical knowledge into practical products. The first device bearing Sinclair's name was to have been a transistor radio kit. He had spotted that import controls were keeping Japanese products out and that there was a slot there for him.

Evidently he had a natural feel for what people wanted, even then. Financial backing, however, was a problem and after Sinclair had left his job to put all his efforts into the new venture, his promised backing fell through. Electronics was relegated to a spare-time activity while Sinclair supported himself with freelance writing.

"Mullard did not think there was a future in digital watches"

One of his first significant commercial ventures was to buy and resell transistor components from Plessey, after grading and testing them. Thus was born Sinclair Radionics, which has a comparatively well-documented history of steady advancement through the 1960s. Its innovatory consumer electronic products included radio and amplifier kits, built hi-fi sets, and in 1972/3 the world's first pocket calculator.

During this period Sinclair's baseline knowledge of what integrated circuits could do, and the practical possibilities for the consumer of the latest chips, stood him in good stead and his products acquired a reputation for clever design and compactness. His 1962 radio kit had featured the novel use of germanium alloy transistors. The class D pulse-width modulated amplifier of 1964/5 used switched pairs of output transistors which, it appeared, leaned rather too heavily on the theoretical possibility of zero rise-time.

It was the adoption of the hearing-aid battery in 1972, along with the adoption of a monolithic seven-segment gallium arsenide display chip bought in from a Canadian firm, which permitted Sinclair to reduce so drastically the size of the calculator, which had previously been powered by the bulky dry-cell torch batteries. Just as the Bowmar display was used with the standard Texas Instruments calculator chip in an unusual way, so Sinclair pioneered the use of integrated injection logic chip in his 1975 Black Watch.

This was where Sinclair came unstuck for the first time. Until then he had stayed one jump ahead of the opposition by either releasing a comparable product to the opposition's at a lower price, or by vastly improving its features and holding the price. It is a familiar pattern to those who know only of the recent growth of Sinclair Research through microcomputers.

Accounts of the Black Watch fiasco vary. The official version runs as follows: "Up to 1976 Sinclair Radionics had enjoyed 15 years of strong turnover and profit growth. However, the company sustained moderate losses due to difficulties with chip supplies for the Black Watch. As a result there were insufficient internal funds available for the final stages of the pocket TV project. Accordingly additional funds were sought".

Sinclair designed the Black Watch, which was the first to have all of its components on one chip. The design was passed out to Mullard for manufacture. who rather late in the day decided to back out. "They did not think there was a future in digital watches. They could have made them, but they did not want to. We were told it was a matter of corporate policy at Eindhoven — we could not get any more sense out of them than that. They never made us any chips", Clive Sinclair recalls.

Disastrous delay

The design was then passed on to ITT, losing Sinclair about 18 months. The delay proved disastrous for a firm which depended on being first into the market with a new product and had already primed the public for a £30 watch where previously they had been paying £80. ITT had terrible problems with yield and, says Sinclair, "did not really keep us informed about what was happening." There were also problems with the production of the watch. In a centrally heated office building with nylon carpets and lots of electrical apparatus the watch was damaged by static electricity discharges.

It was a major setback for Sinclair and soured relations with ITT, who settled a lawsuit brought by Sinclair for £50,000. Ironically, on the eve of the Black Watch's launch, ITT was to have given its executives a Christmas gift of a Black Watch with the message "Best of British technology — ITT and Sinclair", or some such legend. When matters degenerated to the point of legal action, the gift was adjudged ill-conceived and was withheld. Perhaps some unfortunate ITT public relations executive still has a drawer full of Black Watches against the day when they have gained an antique value.

Flat-screen TV

Unhappily, the Black Watch fell at a time when Sinclair had been investing heavily in his Microvision pocket TV. It had been under development for over 10 years, latterly aided by funds from the National Research and Development Council. Clive Sinclair had put a great deal of effort into the flat-screen TV and was loth to let it go by default.

He was faced with the problem either of dropping the TV and reducing the size of the company or of seeking outside investment. He went to the National Enterprise Board, then headed by Lord Ryder, which put in sufficient funds to launch the Microvision in January 1977 — after 12 years and £500,000 investment.

During the NEB era Sinclair had as principal products the Microvision, a range of very successful pocket calculators and a range of digital multi-meters from the instrument side of Sinclair Radionics, which had been steadily earning money throughout the early 1970s. Among the calculators was the Cambridge Programmable, whose price was claimed to undercut the opposition's by up to 75 per cent.

In late 1978 Sinclair introduced the Enterprise programmable calculator which, together with a program library, sold for around £25. It was a sign of things to come, for Sinclair was working on Britain's first personal computer, the NewBrain.

But the rules of the game were changing. Lord Ryder, who had given strong personal backing to Sinclair, left the NEB. The new NEB personnel decided that the future for Sinclair Radionics lay with the instrument side of the business, rather than the calculators and the TV, in the mistaken belief that Sinclair would not be able to compete effectively with the Japanese. The NEB took over the instrument side of the business while Sinclair himself severed his connection with Sinclair Radionics, consistent with his belief that consumer electronics were the key to a profitable future.

In July 1979 Sinclair Research emerged from the ashes, and in the following month the ZX-80 was conceived presumably drawing on the experience gained in

(continued on page 61)

NEW!

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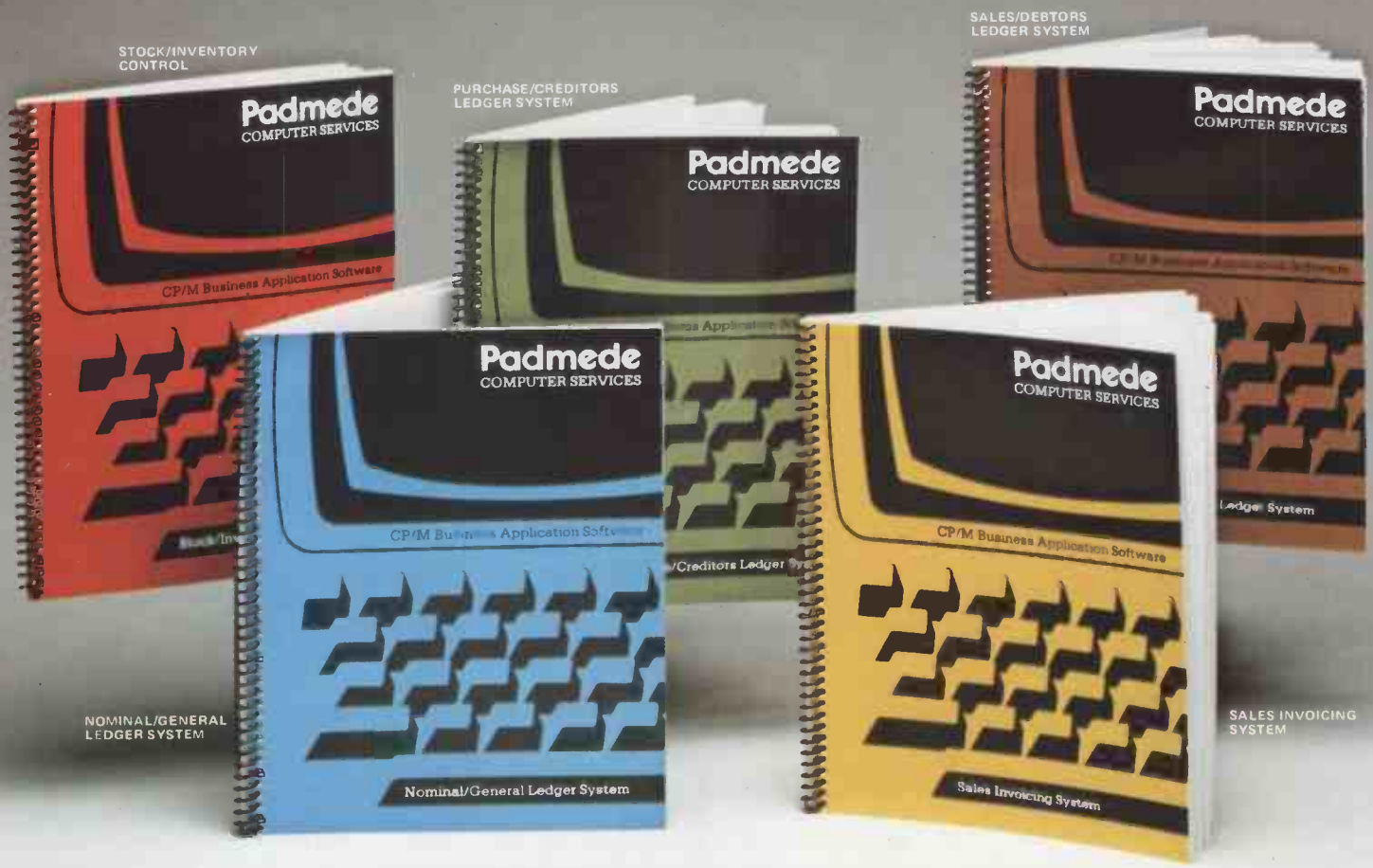

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Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 700 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

uter-

Available now- the ZX Printer for only £59.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (700 mA at 9V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	29.95	
	Sinclair ZX Printer.	27	59.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

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*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable.

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developing the NewBrain. It is a measure of the speed and decisiveness with which Sinclair moved from this point that the NewBrain has only just been launched after being shuffled off to Newbury and Grundy.

Admittedly the NewBrain has been redesigned, but then so has the ZX-80, bringing it down from the 22 chips of the original design to four in the current ZX-81.

Sweatshop chips

As any ZX customiser will tell you, when you open up a ZX-81 you will find chips from all over — Honduras, the Philippines, El Salvador, the sweatshops of component manufacture throughout the world. It is to his experience of component selection that Sinclair ascribes the remarkable success and reliability of the ZX-81: "It is partly due to the small numbers of chips that we use, partly to selecting the right suppliers for the chips. We monitor exactly the failure rate of every part that goes into our machines. And since we know the failure rate, if we detect anything statistically deviant, we can deal with it at once".

One of the first jobs which Sinclair singled out at the formation of the new company was dealing with component sources and reliability: one engineer's sole function is to talk to component suppliers and organisations which test and collect data on chip sets.

Given that the ZX-80 and 81 were well-designed and built, what was it that made them such a runaway success? Why was Sinclair so confident of success that he ordered 100,000 sets of parts for the ZX-80 — exactly the number that were finally produced and sold? "I think there has always been the potential for people to want computers. It is just that we can now offer them at a price which makes it possible. We were always seeking to offer better value for money."

Sinclair has described the hobbyist, with whom he has a great deal of sympathy, as "a dead certainty" to buy the ZX-80. It is easy, of course, to be smart with hindsight, and one of the secrets of business when you are as personally visible as Clive Sinclair is to give your competitors the idea that you are infallible.

Few, however, would have predicted the other market which Sinclair pinpointed — the man in the street who, given a suitably priced product with an attractive and comprehensive self-learning manual, could be tempted into making a mail-order purchase. Sinclair's experience in mail-order selling paid off, and it is a tactic which has immeasurably strengthened his strategy in selling the ZXs, first at home then to France, West Germany, Australia and even Japan, and now, through Timex, to the United States.

The "man in the street" of course uses the ZX rather differently from the enthusiast. He is likely to treat it as a practice tool, to familiarise himself with Basic and to come to grips with the concepts and terms of computing. The enthusiast may well have passed through this stage a long time since, but cannot yet afford anything more elaborate.

Sinclair is amused and gratified by the attention the ZX-81 has received from determined customisers, who fit the machine up with keyboards, character generators, colour cards and so forth until their machine bears no resemblance to the little black wedge shipped out of Dundee. He has, of course, heard that it is now possible to purchase a hard-disc attachment: "Quite overgilding the lily", he comments with a hint of irony.

There is no doubt but that suppliers of Sinclair peripherals and software are kept hard at work. Sinclair has strengthened up the software-marketing side of the business with a new range of approved software developed partly by ICL and partly by the specialist software house Psion, and sold through W H Smith. Clearly he is not yet ready to sit back and let other people cream off all the software revenue the ZX-81 generates.

The 40 per cent cut in the price of the 16K RAM pack might also embarrass sellers of unapproved add-on memories who feel they can carve themselves a small niche by playing Sinclair at his own game. The keener pricing also maintains the separation between the ZX-81 and the new Spectrum.

The Spectrum is not, of course, intended as a replacement for the ZX-81. Sinclair reckons that it will be bought and used by laboratories, research establishments, small businesses and retailers as well as by individuals. If reactions from the dealers are anything to go by — and they are, in the end, the people who have to sell personal computing merchandise — the competition has good reason to take fright.

Cut-throat competition

Sinclair's lavish full-colour advertisement features a point-by-point comparative breakdown of the specifications of the competitive machines. It is bad news for them — so much so that it was reported from April's Computer Fair that dealers were knocking out the Commodore Vic-20 for less than £135, cut from about £200.

What of the home-grown competition from Acorn Computer, which against all the apparent odds made off with the BBC contract and about which Clive Sinclair has been so publicly vitriolic? One of the two chiefs at Acorn, just down the road from Sinclair in Cambridge, is Sinclair's own alumnus Chris Curry. Sinclair bears him no ill-will at all — they still meet socially on occasion — but what sticks in Sinclair's craw is the BBC's attempt to set a standard for software.

"It was nothing to do with Acorn — it was to do with the BBC. I was, and still am, disgusted at the way the BBC handled things. Acorn quite reasonably got the business and good luck to them. I am not complaining about that, I am complaining about the BBC's behaviour. I think they are atrociously amateurish. They are marvellous at making programmes and so on, but by God they should not be making computers, any more than they should be making BBC cars or BBC toothpaste.

"We are always seeking to offer better value for money"

"They were able to get away with making computers because none of us had sufficient power or pull with the Government to put over just what a damaging action that was. They had the unmitigated gall to think that they could set a standard — the BBC language. It is just sheer arrogance on their part.

"I may not know everything there is to be known about computing but really they know very little. It is terrifying: it would not matter quite so much if they were not such a respected authority worldwide, so it makes us have to struggle twice as hard. But we will win hands-down because we know so much better what is needed and know so much better how to do it than the BBC does that our system, our machine and our language will completely win out in any competitive battle.

He relishes the deals with giants like Timex and Mitsui which, like every other aspect of the company, he has a hand in drafting. He prides himself on the fact that the manufacturing licence deals for

(continued on page 63)

Explore the Excellence of your ZX81

With MEMOTECH Add-Ons

NEW

High Resolution Graphics

MEMOTECH ADD-ON £52·00 plus VAT

- Fully programmable high resolution (192×248 pixels).
- Video page is both memory and bit mapped.
- Video page can be located anywhere in the RAM.
- The number of video pages is limited only by your RAM size (each page occupies about 6.5K RAM) and pages can overlap.
- Instant inverse video.
- Switching inverse video on and off gives flashing characters/numerals etc.
- Video pages can be superimposed by software switching.
- Access to video page is similar to plot and unplot commands in BASIC.

The pack comes in an elegant aluminium case, anodised black and styled to fit onto the back of the ZX81, allowing more add-ons (Memopak RAM, Sinclair printer, etc) to be connected without a further power supply. It contains a 2K EPROM monitor, holding a full range of graphics subroutines which can be called by the BASIC USR function or by machine code.

Unique 3 month trade-in offer!

For your future needs, we'll allow you £10 against your purchase of our 64K model if:

you return your 16K pack within 3 months of receipt;

you supply evidence of purchase;

your 16K model is received by us undamaged and unopened.*

**We reserve the right to reject, for discounting purposes, units which have been either opened or damaged in any way.*

MEMOTECH ADD-ON £26·00 plus VAT

Memopak 16K Memory Extension

It is a fact that the ZX81 has revolutionised home computing and coupled with the new Memopak 16K it gives you a massive 16K of Directly Addressable RAM, which is neither switched nor paged. With the addition of the Memopak 16K your ZX81's enlarged memory capacity will enable it to execute longer and more sophisticated programs, and to hold an extended database.

The 16K and 64K Memopaks come in attractive custom-designed and engineered cases which fit snugly on to the back of the ZX81 giving firm, wobble-free connections.

MEMOTECH ADD-ON £68·70 plus VAT

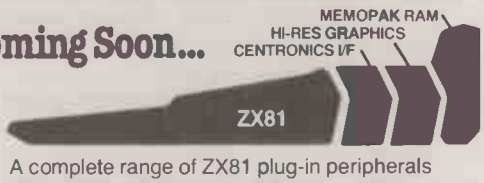
Memopak 64K Memory Extension

The 64K Memopak is a pack which extends the memory of the ZX81 by a further 56K, and together with the ZX81 gives a full 64K, which is neither switched nor paged, and is directly addressable. The unit is user transparent and accepts BASIC commands such as 10 DIM A(9000).

BREAKDOWN OF MEMORY AREAS

0–8K . . . Sinclair ROM **8–16K** . . . This section of memory switches in or out in 4K blocks to leave space for memory mapping, holds its contents during cassette loads, allows communication between programmes, and can be used to run assembly language routines. **16–32K** . . . This area can be used for BASIC programmes and assembly language routines. **32–64K** . . . 32K of RAM memory for BASIC variables and large arrays. With the Memopak 64K extension the ZX81 is transformed into a powerful computer, suitable for business, leisure and educational use, at a fraction of the cost of comparable systems.

Coming Soon...



A complete range of ZX81 plug-in peripherals

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16K RAM @ £26.00 + £3.90 VAT	£29.90		
64K RAM @ £68.69 + £10.31 VAT	£79.00		
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Packaging & Postage @ £2.00 per unit			
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● Circle No. 144

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overseas terrains are costly. Technical leadership, of which he considers himself an exponent, can be quantified in hard cash.

For Sinclair, professionalism is merely the other side of the coin of advanced design: "Professionalism is very important. We have very professional people and we do everything on time, to very tight schedules and with a great deal of commitment. We just are not amateur. There is no room for amateurs these days". Did he think, then, that there were many amateurs still in business? "Oh yes, I am afraid there are still many companies around in the world of personal computers — it is inevitable in any new field — who are far more amateur than they need be".

Ready right away

Did he include in the amateur category the common practice of "kite-flying" — announcing a product with a stupendous specification for delivery "next month"? "Yes there is far too much of that and it is very silly. It mucks up the market-place at the time but it rebounds on the company eventually. They are talking about products that are further and further away. If we announce a product now, it is because it is ready for production. With the Spectrum, we had the pilot run before the launch and those were the models at the launch. The following week it went into production, just like that. It is fully tooled; there is nothing undone on that machine.

"But at the same time our competitors are announcing machines which will not even be ready until next year. They say, 'Oh yes, we have a competitive machine', but they have not even started the darn things. That is absurd. We are at the same stage as they are talking about with our machine of the next generation".

What was his prescription, then, for a successful personal computer manufacturer in future? "You have to have in-house technical capability in every possible area. This is going to be vital in the computer industry — if you cannot make the peripherals, you are not going to be in business in the future. You have to do the printers, the teletext, the floppies, the lot. The Japanese are doing this".

What did he think of the conventional wisdom that the Japanese were strong on hardware but would not make it in software because Basic is so closely identified with the English language? "The Japanese are coming up strongly on the software side, making all their machines IBM-compatible. They can ride on the back of all the software generated by the IBM machine and they would succeed if they did not have to produce a single item of software themselves". Hence, presumably, Sinclair's pre-emptive strike to retain control of ZX and, presumably, Spectrum software by securing worldwide distribution rights to commissioned software of the best quality.

Looking to the future, the ZX-83, as Sinclair called it, would not be a replacement for the Spectrum which he saw as having a very long life. Yet he said the same, less than two years ago, of the ZX-81 which has rapidly fallen into the bargain basement; already recent purchasers of the ZX-81 are kicking themselves for not waiting a little longer.

"The next step will be to make a machine of a suitably higher price which would have a built-in screen and dual floppies — Microdrives, that is. It is conventional in the sense that it contains what the Osborne or the IBM personal computer have, because that is what is needed". But definitely not with conventional 5.25in. floppies? "Oh no. Our Microdrive is miles ahead of what anyone else is doing. We have that working you know — it is not a figment of our imagination, it was working at the show. It is not fully tooled yet.

"We have three elements that people will want: our printer, the flat-screen display, which is critical — the world needs flat screens, that technology is paramount — and the microfloppy, and you bring them all together. That package becomes a much handier package than, say, an IBM system.

How portable is portable? The Osborne, against which the ZX-83 will certainly tilt, is portable to about the degree as a suitcase full of bricks. "We are doing something that is maybe a couple of pounds in weight — say two to four to be on the safe side". This is a product which Sinclair says is due for late 1983 release.

Portable machines

But are people really going to want to trail around with computers under their arm? "Not necessarily. Sooner or later people will not need to carry computers around. If they need one in the office and one at home they will buy one for each place and just transfer, say, diary data. But lots of people do need portability — schoolchildren, for example, or if you want to use it on a plane".

What uses did he envisage for the microcomputer, now it has established itself as more than a hobbyist's toy? What will people do with ever-increasing power and cheaper memory? "Expert systems are what excites me, I think". And for the home — what practical example did he have in mind? "A computer database that has the similitude of the knowledge of a professional expert, that you can refer to in the same way that you can refer a problem to that expert. What I want to see us do, and other people do, is have experts that can be used by people in the home: a doctor, for example, that the family could turn to and say, 'I have these symptoms', and it would respond as a doctor by saying 'There's a lot of it about', or something of that sort".

Could he suggest any other such areas of expertise? "Oh yes, education is the great one. We are a long way from it yet, but things are changing very rapidly and the day will dawn when computers will teach better than human beings, because they can be so patient and so individually attuned". A future *Encyclopedia Brittanica*, as it were? "No, it will replace not the *Encyclopedia Brittanica* but the school".

"The Microdrive is not just a figment of our imagination"

Surely there was a threat here to normal personal communication? Did he not fear that the computer might have a de-socialising effect on people? A recent report in *New Scientist* suggested, for example, that networking buffs became withdrawn from their everyday lives and preferred to communicate with their on-screen pals. "Yes, I am concerned with this. We have to watch very carefully that you do not remove the rituals of things like shopping or banking. Sometimes it is possible for something to disappear before people realise that it is what they want to keep".

Nevertheless, an RS-232 and networking interface for the Spectrum will be available later this year. "I think sending letters is a particularly elegant way of using small computers, without being a threat to any existing social activity". Further uses of the network capability would be to link into larger-scale fixed databases as well as sharing expensive peripherals such as letter-quality printers which would probably be in the form of an optical disc. Sinclair does not discount

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the possibility that the technology to write to an optical disc will eventually become available to the individual, but though he is keeping abreast of the latest developments, he says that Sinclair is not itself doing any work on laser-driven stores.

"That is what I like doing — solving problems"

Pursuing the point about the computer becoming a substitute for real life. I asked Sinclair what implications he saw in the laser-driven store, linked to a battery of large flat-screen TVs. Indeed, "the high brightness of thin CRTs makes them ideal for use in projection systems", says Sinclair's business briefing, which foresees "a three-tube projection TV with a 50in. diagonal full-colour display. The optics and electronics could be fitted into a shoe-box-sized unit projecting on to a wall-mounted screen".

Under microcomputer control with real-time response to user inputs, such an outfit could become an altogether more powerful and interesting activity than normal experience. It would give the user the kind of experience which is now only to be had in some extremely expensive military and flight-training simulators. In response, Sinclair laughs: "'Fraid so". I have heard it said that, including professional use, two-thirds of computing work goes on games. I should think it would make life so jolly boring that you would not want to come back to it. If you could simulate it that well.

Did he feel that computers had any practical benefit in improving the human lot? Had they made life more complicated? He is said, after all, to prefer the simple life and laughs at the idea of using a computer himself: he does not even use a calculator, preferring a slide-rule or just working in his head. "I am all for the simple life, yes. But there are certain tools around that are useful at times. It simplifies buying an airline ticket, or getting cash at any time of day or night — these are simplifying things, no matter what sort of life we lead".

Even if one lives the life of the noble savage, tilling the land, where the only money we have is the cash in our pocket? "No. But I am very glad my life is not just tilling land. It would be very dull and boring".

Does he believe, then, that humans are becoming brainier? "No", he rejoins with some warmth. "Dimmer, if anything". He certainly believes that intelligence is innate, a matter of genetic inheritance; the fact that computing is an intellectually demanding skill does not mean that the brain's capacity is increasing. "I just do not believe we have become cleverer — whoever designed the axe or the wheel was just as clever as we are".

He finds no evidence that computers will help to make a better world, — it can be clearly seen that the very best, most highly-specified and supported research and development into computing goes into producing defence and military systems.

Sinclair has been asked to do military work, and has turned it down. He was, he says, "worried about its implications". This was a decision based on principle, though he does not rule out the possibility of doing so in a state of urgent national necessity, again reflecting the bedrock patriotism which underlies his political and business stance over the years. Sinclair believes, reassuringly, that the engineer should have a conscience, and a consciousness of the consequences of his inventions. He is an admirer, in his own field, of Newton and Edison, of the great railway and shipbuilding engineer Brunel, and as a boy his hero was Einstein.

Unlikely mentor

That master theoretician must seem like a curious ideal for Sinclair, who is identified above all with his own products. But Sinclair's own way of working is very spare, very abstract. After all, mathematics is his first love, and he says that what really interests him is "problem-solving". These are not the immediate problems of production engineering, which is now able to delegate; they are the problems of design, pure and simple.

Sinclair has spent much of his time recently on solving the design of the flat-screen TV. "The most interesting job there was mathematical", he says. "Most of the interesting jobs cannot be done on a computer. There was a curiosity of the flat tube's design which would not come out of the computer analysis, so I had to do it. That is what I like doing — solving problems".

Astonishingly, Sinclair still manages to pursue a wide variety of leisure interests. He is an economics undergraduate at King's College, Cambridge, he is chairman of the British Mensa society, he keeps up his interest in mathematics and he still reads novels. Recently Sinclair established a partnership with an old friend, Patrick Browne of Brownes Bookshop in Cambridge, setting up a publishing company with a planned list by the end of this year of 20 titles. As a common theme they will have "a progressive approach to the problems of contemporary society". He is also sponsoring a £5,000 fiction prize to be awarded to the author of a "novel which is not only of great literary merit but also of social and political significance".

A good read

What was intended by "a progressive approach to contemporary society"? "Something that has a social content and is interesting to read — like Dickens. He had a social point and was a marvellous read. We thought that the Orwellian type of novel had not had much of a look-in recently". He will play no part in selecting the winner of the prize which bears his name.

Perhaps the most interesting of Sinclair's hobbies is music, a subject on which he is more passionate than anything else than perhaps the BBC and which is reflected in his trusteeship of the Cambridge Symphony Orchestra. Music has long been thought to have an affinity with mathematics: the one is the most abstract of the art forms, the other the most abstract of sciences. He agrees that composing a piece of music would in some way be analogous to designing a circuit, describing both processes as "an optimisation technique". Surprisingly, his tastes run to the romantic: he prefers Beethoven to Bach, Stravinsky to Bartok, and thinks it is a toss-up between Vivaldi and Albinoni. His favourite is Schubert, particularly the Quintet in C.

Sinclair does not play an instrument, but says he will one day find the time to pick up the pieces of his piano playing from school. He would find it most satisfying, he says, to practise the manual skill of fingering; while doing his scales, he would be able to think about other things. That sort of manual skill, he says, is indispensable, a prerequisite to playing with feeling. "But it would have to be the piano", he says. "Nothing else would interest me . . . and of course you can get away with being really bad. I would not aim to be brilliant, just adept enough to amuse myself."

Looking forward to a long Bank Holiday weekend Clive Sinclair observed, "Any excuse not to work". Somehow one suspects he cannot quite mean it.

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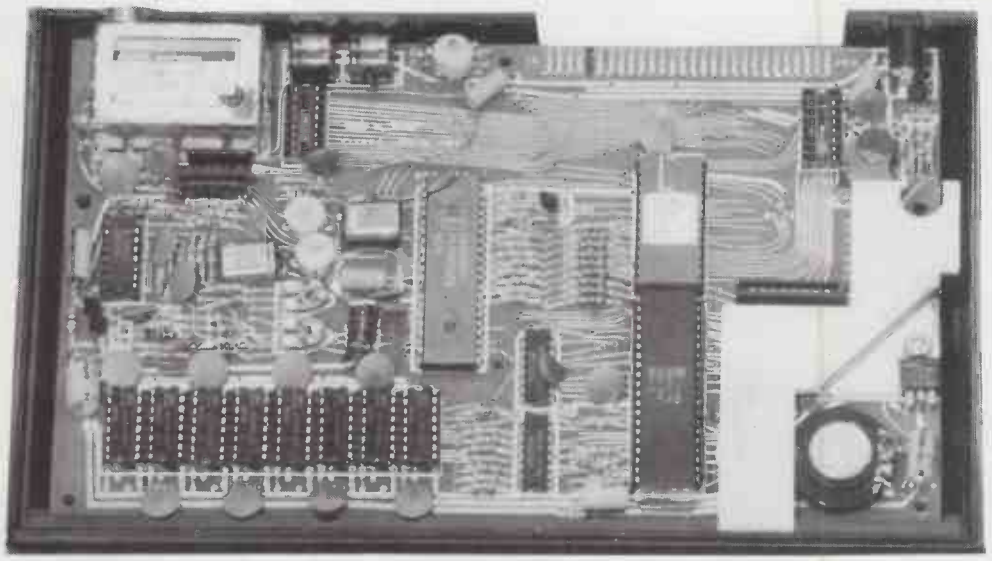
The successor to the ZX-81 has colour, sound and high-resolution graphics. Bill Bennett finds that Sinclair has not lost the knack of presenting an attractive consumer-orientated computing package.



SINCLAIR SPECTRUM

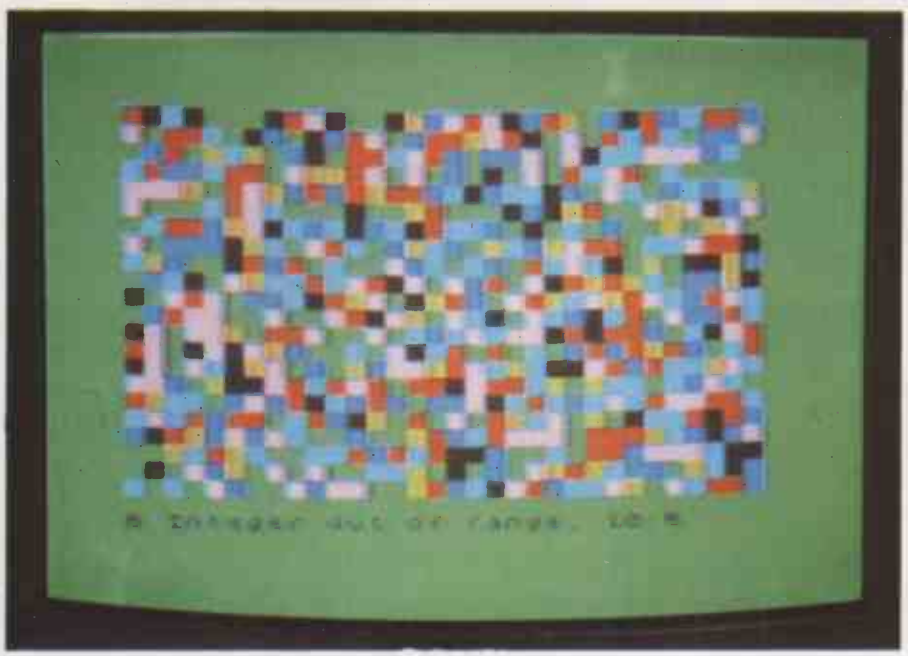
AT FIRST SIGHT the Spectrum is not very impressive: about the size and weight of a good book, made of black moulded plastic with four rows of soft plastic keys. The styling is good — far better than the ZX-80 — and the weightier feel certainly adds to a "quality" air about the machine. The case is wider than the ZX-81 — nine inches as opposed to just over six. Its height is more constant than the 81's aerodynamic-style wedge, and at under six inches from back to front it is rather less deep than the ZX-81.

On the top of the keyboard is a coloured spectrum flash, which hints at the colour capabilities of the new micro. The keys take up far more space than the horrible keypads on the ZX-81, but each one still has five or six different codes, letters or symbols attached to it in true Sinclair style. One extra key not present on the ZX-81 is the symbol shift.

The Spectrum keys have a positive feel to them; you can actually feel them move down when you press them, and this positive feedback is supplemented by an audible click which confirms that the key has been pressed. The click is the same whichever key is pressed, though it does not sound on the shifts.

Before trying the computer out, we took a look at the hardware. The power socket, microphone, earphone and television sockets are all located at the back of the case. This is a much better arrangement than the ZX-81 as the various cables are less likely to overlap and thereby cause interference problems.

Multicoloured graphics are restricted to a low-resolution grid.



Also on the back is the point where the control lines leave the micro; it is just like the ZX-81 expansion socket except that there are five more lines. This presumably has something to do with the Microdrives which will be available later as add-ons.

Gaining access to the inside of the case is fairly easy, after removing the five screws on the back of the computer. Although the Spectrum has the same little rubber pads underneath as the ZX-81, to stop it scratching dining-room table tops, there are no screws tucked away beneath them. The two halves can be pulled apart gently to reveal the two ribbon cables connecting the bottom half of the case — which contains all the electronics — to the top half which contains the keypads. The ribbon cables can then be pulled out of their sockets.

Moving keys

The keypad section in the top half proved particularly interesting. We pulled off the metal overlay with all the stencilled command name, and found underneath it a rubber mat into which the keys are moulded. Although this mat is, to say the least, aesthetically displeasing, it is most certainly an ingenious way of giving each of the "keys" individual movement. The rubber mat must be extremely cheap to produce, and underneath it is what can only be described as a membrane matrix pressure pad, similar to the ZX-81's.

The matrix is made of two sheets of a transparent film, printed with white tracks. At the points where the white

tracks overlap are little circles which are obviously the touch-sensitive pads. The ribbon cables are printed directly on to these films; the right-hand track is on the bottom and accesses the rows, and the left-hand cable is on the top film and accesses the columns. This arrangement is complicated by the way that it is split into two halves in the middle.

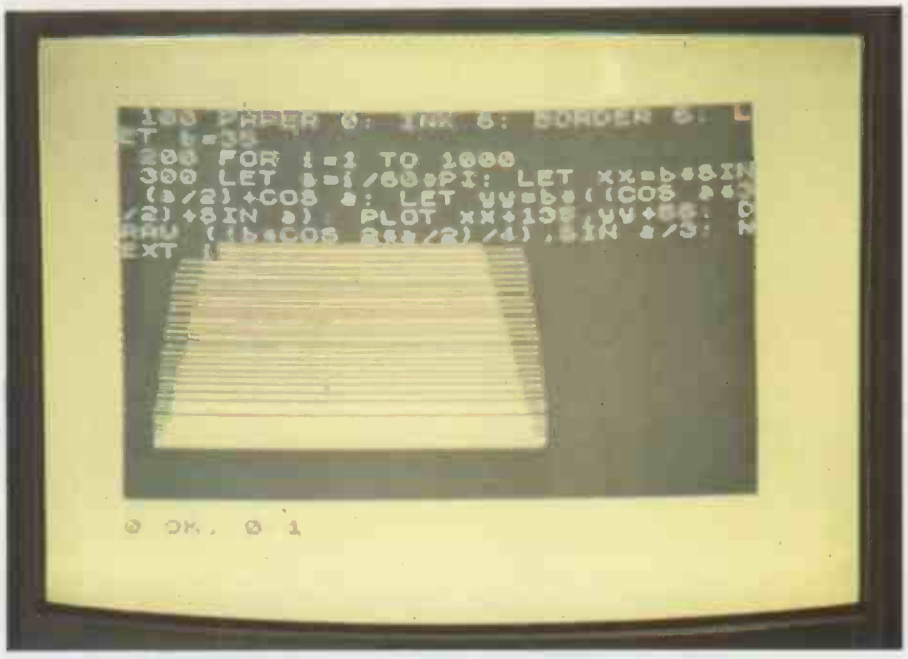
The film is punctured by a series of holes which locate it on to the plastic case, which is in turn covered in projections. These projections go right through the film to locate the rubber mat as well. There is another series of projections on the plastic casing, which are mirrored on the underside of each individual key on the rubber mat. These, no doubt, serve to press the membrane and ensure a positive "contact" at the switch.

Sinclair's trump

In effect the Spectrum keypad system does not represent much of an improvement on the ZX-81 keypad. The technology is essentially the same, though it has been packaged in a much better way.

The bottom half of the Spectrum case contains the main electronic works. They all sit on a fibreglass printed-circuit board, which is remarkably small considering the power of the Spectrum. This is Sinclair's trump card: even if its machines are not necessarily the most powerful on the market, they are always technically impressive because so much computing is condensed into so few components.

There are rather more chips on the Spectrum PCB than on the ZX-81 board. Most of these extra chips make up the 16K of RAM, which previously sat in a separate box which fitted on to the back of the ZX-81. RAM accounts for eight of the 14 chips in the Spectrum. There are a couple of "spare" sockets on the board we tested, which will presumably take some extra ROM — possibly to drive the ZX Microdrives or the RS-232 interface.



Text and high-resolution graphics can be combined on the screen.

The voltage regulator has an oddly shaped heat sink attached to it, which should dispose of enough heat. Cooling has been a problem with previous Sinclair Research computers, that are often left on for hours by addicted programmers. In the centre of the board is the CPU, the ROM and an uncommitted-logic array.

The implementation of Basic included in the ZX Spectrum is so much better than the ZX-81 version that the two appear practically unrelated. Unfortunately the major disadvantage of Sinclair Basic has not been ironed out: commands and code are all entered by "single-key" input of the codes, or that is what the publicity claims. In fact most of the commands and functions require at least two key strokes, and sometimes more.

This method of entering Basic code is annoying for two reasons, firstly because the number of key depressions required to access certain codes add up to more depressions than it would take to spell the word out. For example, the arctan function has the three-letter code ATN. To input this code on the Spectrum you have to press Caps Shift and Symbol Shift until the cursor changes to an "E", then press down on Symbol Shift and the E key at the same time.

An acquired taste

A total of four key depressions needed for a three-letter code. To most of us this is a very complicated way of doing things, though to hardened ZX-81 users all the shifting and so on may have become second nature.

Most people who are used to computers with real keyboards perform a style of touch typing, and a modestly experienced user of a real computer can enter a short program in next to no time. Such an economical and obviously sensible approach to using the computer is denied to the Spectrum user. Touch typing is out of the question, though the keyboard "click" — which is so quiet as to be all but inaudible in a busy office — and the positive feel of the keys does go some way towards helping. If you would like more feedback you can try Poking location 23609 with a value of around 200, which converts the key click to a short bleep which is more likely to be heard.

The Sinclair single-key system is likely to lead users familiar with other machines into a number of irritating errors. The most common of these is accidentally typing in keywords, rather than using the single-keystroke entry system, or omit-

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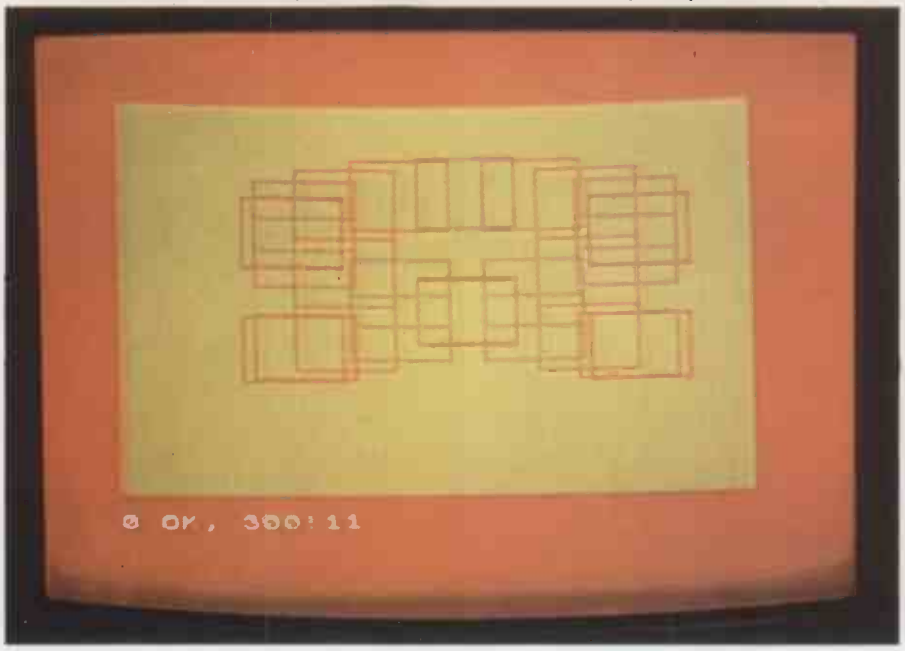
Plot and Draw commands operate with a resolution of 256 by 192 pixels.



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ting the Let statement which most other micros manage to do without. Most dangerous of all is the possibility of obtaining the wrong symbol or function off of a key because the Shift keys are not engaged. This can be most frustrating when using the cursor movement keys while in the Edit mode, with 8s and 5s appearing all over the screen.

Another serious design fault of the key-entry method is having New as a command available on the A key: it is much too easy to hit it and lose your program altogether. All-in-all, our main criticism of the Spectrum is the keyboard and the single-key entry. While Sinclair retains this on its microcomputers they will never be serious tools. As training aids and toys they are superb but any microcomputer buyer requiring a machine for serious work is likely to need a proper keyboard. In this respect, and this alone, the Spectrum does not compete with the BBC Microcomputer.

Everyone in the business expected the Spectrum to have a proper keyboard, and the fact that it does not is undoubtedly a weak point. The machine is sure to sell — and it should sell well — but until some enterprising designer comes up with a hardware fix, giving the Spectrum the touch of class, it cannot be recommended as a tool for the serious user for all its good points. Home computing is the big market of the moment and that is where the Spectrum is aimed.

Among the significant improvements to the Sinclair Basic found on the Spectrum are the inclusion of the Data statement, together with the associated commands Read and Restore. Also added to the Basic are the commands Def FN and FN which allow users make up their own functions or composites of other functions.

Extra symbols

The Fast and Slow commands are dispensed with but there are a number of extra symbols available via the keyboard. These include a whole range of commands for the forthcoming ZX Microdrives, some graphics commands and Beep. The Spectrum uses the ASCII character set, Sinclair Research having at last moved some way towards standardising with the rest of the world.

Another advance over earlier Sinclair machines is that multiple statement lines are allowed. Sinclair Research claims that the string-slicing mechanism in ZX Basic is extremely powerful, and we did prefer it to the more normal Right, Left and Mid.

The string slicer works by including a bracketed expression after the string or the string variable that is to be operated on. This expression may contain other expressions and may or may not contain the word "To". The string is sliced from the element pertaining to the value of the expression before the word "To" up to and including the element corresponding to the expression after the word "To", for example:

"abcdef"(2 TO 5) = "bcde"

If there is no expression or variable before the word "To", then it is assumed that the required string starts at the first element. If there is none after it, the end of the original string is assumed to be the end of the new one. If the word "To" is used alone the whole string is the resultant, and if only one variable without the word "To" is used then just that single element of the string is extracted. This is a very neat, precise and easy-to-use construct.

The rest of the Basic, apart from the graphics, is fairly standard. Inkey$ has been added to read the keyboard and Pause to stop the computer for a defined length of time. One thing we like about

(continued on page 70)

A multitude of functions is available from each key. The moving keys provide some welcome tactile feedback, but are revealed to be moulded from a single rubber sheet, and to bear on a pressure-sensitive keypad — truly a masterpiece of product engineering.

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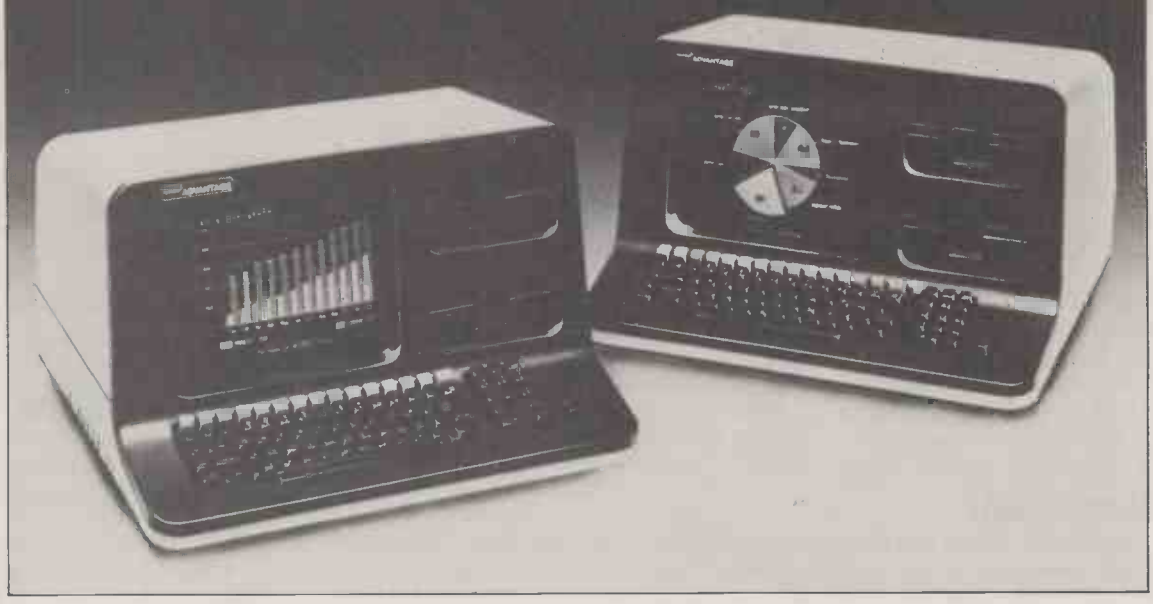

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(continued from page 68)
the Spectrum is the trigonometric functions, which are invaluable for the scientist or maths student. Sinclair's old programmable calculator made the processing of experimental data that much easier, and the Spectrum will be an ideal tool for this kind of work.

Beep is the command which invokes the Spectrum's sound-generating utility. This sound can be heard thanks to a very small loudspeaker which sits inside the Spectrum. Underneath the speaker in the bottom of the case are a series of holes which let the sound escape. Though the sound from the speaker is not very loud, the Mic or Ear sockets on the back of the machine can be connected to an amplifier to produce really loud sounds.

Beep is not as flexible as the music-making facilities of the Commodore Vic-20, or the BBC Micro but it is easy to use. The first value entered after the keyword gives the duration of the sound to be played, in seconds. We did not establish the upper limit — it is longer than anyone was prepared to listen.

Atonal music

The second value gives the pitch of the sound which may be specified as an integer or a decimal number. The value 0 gives middle-C, 1 gives the next semitone, C-sharp, adding one gives the next semitone and so on: adding 12 raises the pitch a whole octave. Negative numbers give pitches below middle-C. The maximum value is about 70, a good six octaves above middle-C and a much higher pitch than any of us could hear — perhaps a sheepdog would appreciate this facility. By using decimals you can program quarter tones which are used in Arabic and Indian music, and still smaller tone intervals are possible.

The graphic capabilities of the Spectrum are a major selling point. In monochrome they are excellent, though there are shortcomings in colour. It must be remembered that the Spectrum costs much less than its nearest rival, and its graphic capabilities are only slightly behind. For example there are 256 by 192 dots on the screen, compared with a maximum of 320 by 256 on the BBC Model A and 176 by 160 on the Vic-20. Graphics commands include:

Plot — fills in a pixel at a designated location on the screen,
Draw — draws a line to the point specified,
Circle — draws a circle around a specified point of a specified radius,
Point — tells the user whether a pixel is inked in or not.

Draw can be used in two ways, either plotting a straight line or a curved one, the angle being specified in the Draw command. These commands can be used with Inverse and Over.

Paper and Ink are the two statements which define the colour of the background and the colour of whatever is being superimposed on it. Border defines the colour of the edge of the screen around the Paper, which is over half the area of the screen. Inverse and Over are really associated with the colour facilities of the Spectrum. Draw Inverse will draw a line, in the Paper colour, and Draw Over will change the pixel from whatever it was originally.

There is a choice of eight colours, but with some clever programming, using the character generator and a combination of colours, it may be possible to derive some more. The basic eight colours are black, white, blue, red, magenta, green, cyan, and yellow.

One drawback is that the Ink and Paper colours can only be defined to the nearest character location, that is one of the 32 by 24 locations on the screen. This can be rather frustrating if, say, you want to display a map or design an intricate display. Another real annoyance is that the colours appear to vibrate on the screen, especially at the borders of certain colours. Very quickly the effect becomes a strain on the eyes.

It is also possible to Flash and Bright the colours in a location, using commands which are self-explanatory. For normal, low-resolution graphics this works well, the user being restricted to Tab, Print At, and the usual graphic character set.

The commands that are to be used to control the forthcoming ZX Microdrives are available from the keyboard like any others. We have not had a Microdrive to test, but in a demonstration at the Spectrum launch a chess program was loaded from the Microdrive in less than one minute. Up to eight Microdrives can be connected to each Spectrum, each one holding up to 100K on a microfloppy. They are capable of churning out data at a speed of 16K per second.

Though the novel "half-way house" keyboard is a serious drawback, adding a proper keyboard might not be too hard, especially with the RS-232 interface board that is forthcoming. Together with the Microdrives the interface may form the basis of whole ranges of simple and cheap applications packages to attract serious users. The Spectrum is probably a little slower than more up-market micros, but its extremely low price will mean that no business need be without a computer.

At present Sinclair Research is saying that the ZX Microdrives will be along "later in the year". They will sell at the incredible price of around £50 each. As yet there are no details about the actual tapes, discs or whatever it is that holds the information in the drive. Once they are available some very interesting software should follow, perhaps from ICL which is said to be working on cassette-based software for the Spectrum now.

There is an extra feature of the Spectrum's tape-handling system in the form of the Verify command which lets the user check that what is stored on the cassette tallies with the program or data in memory. The Screen feature allows a whole screenful of information to be stored as a separate file. Among a number of possible applications of this command a screen can be displayed while another program is loading.

Specifications

Microprocessor: Z-80A running at 3.5MHz
Languages: 16K ROM containing Basic and operating system
Memory: 16K or 48K RAM
Keyboard: 40-key moving rubber keypad
Display: 256 by 192 pixels, or 24 lines of 32 characters; eight colours; sound
Interfaces: cassette I/O; usual Sinclair expansion port with extra lines; optional RS-232 interface
Printer: can be connected to Sinclair ZX printer
Size: 233mm. wide, 144mm. deep, 30mm. high

Printer options

The Spectrum will work with the ZX printer, which is capable of reproducing the high-resolution graphics though the printout paper is only four inches across. Most *Practical Computing* readers would wince to see the ZX printer in action, but it is perfectly good for the thousands of home-computer users who own one. The RS-232 interface should enable a dot-matrix printer to be used with the Spectrum.

The manual for the Spectrum comes in two parts, both books are written by Steven Vickers and Robin Bradbeer, who have done a very good job. The first is really an introduction for people who are new to computing. Between the two volumes there is just about everything anyone could want to know about the Spectrum. The cover of the manual has another space-age painting: it is pleasing to see that the arts are being patronised.

Conclusions

● By any criteria the Spectrum represents a significant step in the history of microcomputers. It brings to the lay user a computing power that a few years ago could only be provided by a huge mainframe.

● Undue criticism of the Sinclair on the grounds of the imperfect keyboard and the odd way in which Basic commands are entered seem churlish when one considers the £125 price tag, yet without the addition of a full typewriter-style keyboard the Spectrum will not be an effective business tool.

● The addition of a serial interface and cheap on-line mass storage — the Microdrive — go a long way to correct these deficiencies.

● As a toy, learning tool and aid for students the Spectrum is invaluable. As a consumer artifact it will change the way that many people think about computers.

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ATARI 800 GRAPHICS

IF I TELL YOU the last program I typed into my Atari was a version of Space Invaders, you will not be surprised: such games are all too common. The game is fast, in high-resolution graphics, uses seven colours on the screen at once and has sound effects. When you learn that the game takes only 47 lines of Basic, including five lines for the title, then you will admit that the Atari micros must have some remarkable features.

The Atari contains a trio of custom-designed chips called Antic, GTIA and Pokey. Their extensive capabilities are relatively simple to access, though not always so easy to access well. From the point of view of the programmer, simple instructions produce impressively complex results.

The Atari's power has only really been applied to games, in keeping with Atari's avowed intention to take over the home computer market. Yet there is no reason why the Atari 800, at least, should not have many business uses: the built-in

Sample screen display showing all 16 available colours at equal luminance.

sound and colour facilities could be used to enhance many boring business programs, and anyone who can produce a joystick-operated accounts program that is even half as much fun as Atari's Centipedes is all set to quadruple staff productivity.

The Atari 800 console is fairly compact at 16in. by 12.5in. by 4.5in. and the machine weighs under 10 pounds. It is solidly constructed and well finished. The QWERTY keyboard has 57 full-stroke keys with auto-repeat, plus four function keys labelled System Reset, Option, Select and Start. The System Reset key is protected by a raised moulding, though you do not lose the program irretrievably if you press it by accident. The three remaining special keys are all programmable from Basic.

The 800 console has seven output points, one of which is hard wired and carries an RF modulated signal to a domestic colour TV. There is a monitor outlet socket which could also be used for a VCR or video disc. One serial input/output port is available for connecting the Atari to a cassette recorder or disc drive. Other peripherals have two sockets, so they can be daisy-chained.

Alternatively you can connect the socket to the 850 Interface Module, which provides ports for disc, printer, Modem, and three extra RS-232C-compatible ports. There are four ports on the front of the machine for joysticks, paddle controllers or keypads, or a light-pen. A cheap numeric keypad can be simply plugged in to make up for the lack of a separate numeric pad on the keyboard. The outlet ports are easily software controlled. A red LED on the keyboard indicates power on.

Flip-top design

Lifting the hinged top of the 800 reveals two slots for 8K plug-in ROM cartridges, such as Star Raiders or the Basic or assembler/editor language cartridges. Lifting the back of the top reveals a genuine 10K operating system and the memory boards. For the user to add or remove, say, 16K of memory takes less than a minute. The flip-top design has the disadvantage that you cannot conveniently stand a monitor on top of the console.

Plugging in the 8K Basic language cartridge and powering-up puts the Atari 800 into its fundamental mode, Graphics 0. This provides a 40-character by 24-row text display with white characters on a blue background. Pressing a Caps Lower key provides access to a lower-case character set with true descenders: upper case can still be accessed using one of the two shift keys, just like a typewriter.

A set of graphics characters can be accessed by pressing the Ctrl key, and the inverse character set by pressing a key with the Atari logo on it. There is also an Esc key for entering characters like clear screen without them clearing the screen.

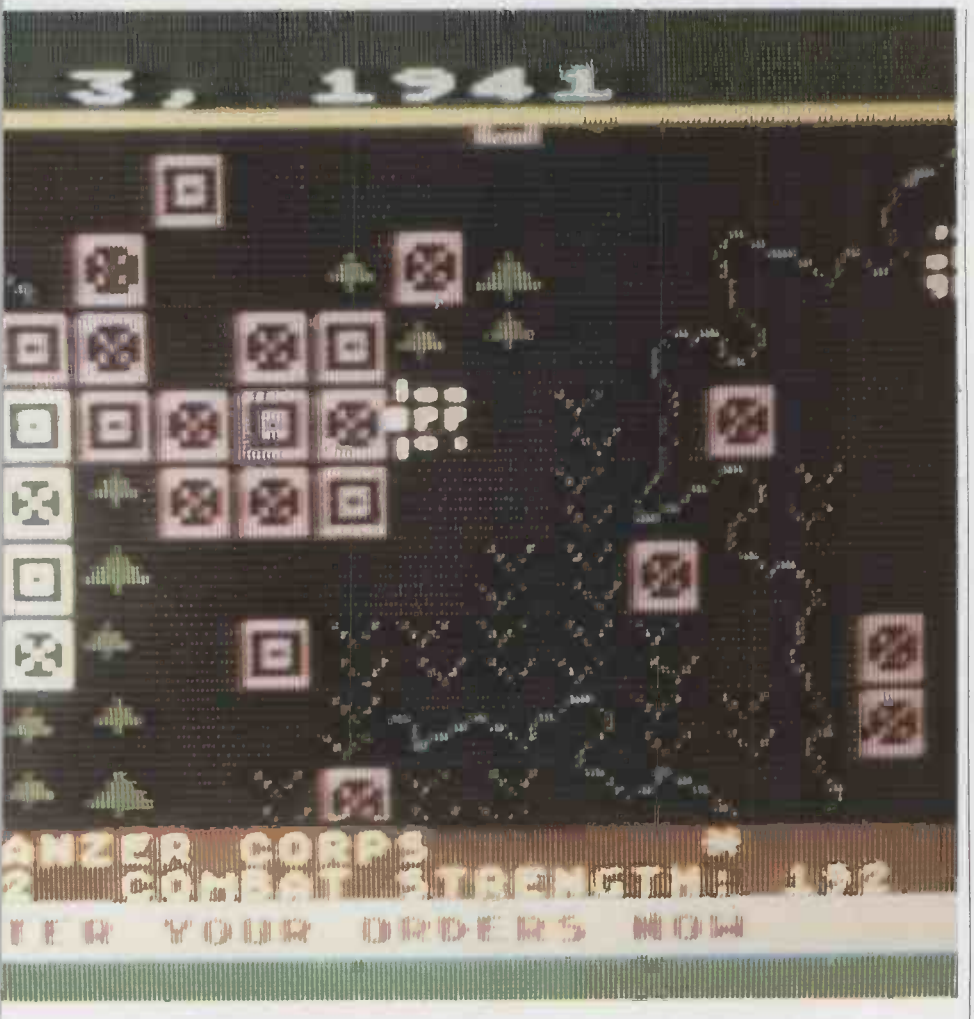
Program editing

The 800 provides full screen editing with simple four-way cursor movement. You can also insert or delete either single spaces or lines, which makes program editing simplicity itself and word-processing programs easy to use. There are default tabs 10 spaces apart, or you can set tabs and screen margins separately — again, as on a typewriter.

Basic programming is done in Graphics 0, normally in upper case as Basic does not recognise lower case. A glance at the list of reserved words will show that most features are available. The Atari's Basic does not support arrays of strings, which can be infuriating at first. However, there are always other ways: anything you can do with string arrays you can also do with long strings, though not the other way round.

String arrays are not part of American Standard Basic, nor are they a feature in the Microsoft form of languages like Fortran, Cobol, Pascal and Forth, so people who wish to advance to these languages are probably better off not learning to depend on string arrays. Atari probably went for long strings because the U.S. educational market is so heavily influenced by the HP-2000, which uses 72-character strings. There is no limit to the length of a string on the Atari, though sub-strings can only be up to 99 characters. It has been said that the designers had a choice between string arrays and error checking on line entry, and certainly Atari error checking is a more valuable feature.

Another minor irritation of Atari Basic is that user-defined functions are not allowed. Of course there are other ways round this too, and a number of functions are built-in, including CLog — logs to



Best-known for their video-game cartridges, the Atari microcomputers tend to be ignored as serious machines. Jack Schofield argues that the unusual graphics features of Atari Basic deserve more attention from programmers — and not just for games.

base 10 — and Exp. In other respects Atari Basic is extremely powerful. You can use long variable names, for example, without paying a heavy penalty in memory use. Variable names are stored in a table, and once entered, the name costs the same amount of memory to look up, regardless of its length. You can Goto a variable name and you can use most reserved words or parts thereof, except Not, as variable names too, as reserved words are stored as tokens.

Tokenised for speed

Atari Basic lines allow multiple statements, with a logical line equal to three screen lines. When a line has been entered, the third byte of the tokenised line holds a figure for the length of the line, which makes line skipping following a Goto instruction relatively speedy. Incidentally, all numbers are stored as binary-coded decimal floating-point numbers, except line numbers which are stored as two-byte integers.

The longer reserved words have useful abbreviations to save typing, for example

L. — List
GR. — Graphics
DR. — Drawto
SE. — Setcolor
C. — Color
I. — Input

When you List the program, the Basic expands these abbreviations to the full form of the word. though it does not expand ?. used to mean Print. It also inserts any spaces you may have left out, so there should be no stupid, unreadable lines full of the all-too-common Basic gibberish such as

IFX=Z1ORZ2THENZO=100

or similar rubbish. The tokenised line storage means that this is also memory efficient.

Syntax is checked on line entry. Incorrect lines are reprinted by Basic with Error in front of them, with a cursor to show the position of the error. The cursor appears just after the error, not on top of it. When the program is run, errors produce an error message and line number on the screen, such as

ERROR 6 at LINE 20

You then have to look up the number to find out what the error is. You could use the Trap command to convert the messages to read, in this case,

OUT OF DATA ERROR AT LINE 20

and so on.

The Trap command is a form of "on error Goto line XXX" facility, so you can return to an Input line where an incorrect input was made without stopping the program. It is a very rugged technique. As you can Peek the line number where the error occurred, one Trap routine will take care of all the input errors, with Trap 40000, or any oversize number, being used to clear the trap.

This two-line program avoids too much worry about where you position the tape when loading from cassette with CLoad:

```
10 TRAP 20:CLOAD
20 TRAP 40000:GOTO 10
```

The first line sets the trap so that a read error does not stop the loading process, but sends you to line 20. The second line resets the trap and continues the program.

Other useful commands include

Pop — allows you to take the top entry off the stack if you do not want to return from a subroutine;
XIO — a "fill" command for graphics;
USR — allows you to call a machine-language subroutine from Basic.

Paddle and Stick are Basic commands used to find the value of paddle and joystick controls. PTrig and STrig are used to find if the fire-button is pressed or not. With four ports to control, selection is from Stick(0) to Stick(3) for example.

Basic control

The graphics and sound facilities can all be controlled from Basic using special commands like Setcolor or using Peeks and Pokes. It is in the graphics and sound capabilities that the Atari micros excel, with complex facilities that are simple to access from Basic.

Sound is controlled by Atari's Pokey chip. Four separate voices or sound channels use the TV loudspeaker, and there is a "beeper" loudspeaker on the console which is used, among other things, to signal errors like "line too long". The Atari 410 cassette recorder has both digital and audio tracks, so recorded voice and/or music can be combined with programs. This facility is used in Atari's educational cassette series, which includes *Invitation to Programming* and various language courses. The computer

(continued on page 77)

Single-colour graphics routine, using variable luminance to give a sense of depth.

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● Circle No. 150

(continued from page 75)
controls the cassette motor by using a Poke.

The four voices are controlled by Pokes or from Basic. Commands take the form:

SOUND 0, 121, 10, 8

where 0 is the number of the voice, 0 to 3; 121 is the frequency of the note, from 0 to 255; 10 is the sound quality, even numbers from 0 to 14; and 8 is the volume from 1 to 15.

Sound quality

The "quality" rating is the amount of distortion in the sound, which can take you from a white noise sound to a fairly pure tone. Obviously the range of potential effects is enormous, especially as Sound statements take variables as well as numbers. Particularly interesting effects can be produced by using a variable in the distortion value. Spaceship noises and explosions are also fun to do.

If you want to play notes and tunes you can turn the keyboard into an organ, or use Read and Data statements with look-up tables so you can enter notes like C or G rather than numbers. Duration and attack must be controlled using delay loops. Sounds are ended by entering

SOUND 0, 0, 0, 0.

Atari also offers a plug-in ROM called Music Composer for composing and arranging tunes.

The graphics routines use two LSI Atari chips called Antic and GTIA. Colour routines are accessed in a similar way to sound routines. First you use the Setcolor command, such as

SETCOLOR 0, 1, 4

which is like choosing a palette, and then Color 1 or Color 2 to set a particular colour.

Setcolor offers five colour registers, defined by the first parameter. The second value is the hue number — see table 1 — and the third value is the luminance or brightness in the range of even numbers 0 to 14. This luminance capability gives the Atari a range of 128 colour effects. A colour which appears red at luminance 0 can appear almost white at luminance 14.

Text on border

There are 12 fundamental graphics modes available, and the number of colours available varies according to the graphics mode in use, which also governs the resolution of the display.

TV sets are normally designed to overscan, taking the picture off the edges to prevent unsightly borders. This is fine for TV but not for a computer so the Atari is designed to use a central display area, with a border to fill the edges of the screen. The screen and border colours can be controlled by direct Pokes or Setcolor commands. If you wish, you can put text on the border, though this is not normal practice.

ROM cartridges may be plugged into the slots behind the Atari 800 keyboard.

The central screen has a resolution which ranges from 20 by 12 — a text mode with double-size letters to 320 by 192 pixels. Graphics modes have a four-line "text window" at the bottom of the screen; it can be removed by adding 16 to the graphics mode instruction. You can display text on a graphics screen, and it is also possible to use more than one mode on the screen at the same time by using the Display List Interrupt provided by Antic.

The number of colours available, and the amount of RAM required, varies for the different screen modes. Graphics 2, for example, is a five-colour mode which uses only 261 bytes, while Graphics 7 is a four-colour mode requiring almost 4K. As the user can change modes at any time, it is an important point that screen data can be held anywhere in RAM. This also means you can store several screens in different places in RAM and then use a three-byte instruction

jump to address — low byte, high bytes

to change from one to another. This technique is called "page flipping", and can be used to provide a degree of animation.

Table 1. Setcolor codes and colour Pokes.

Colour	setcolor number	Poke number
Black/white	0	0
Rust	1	16
Red-orange	2	32
Dark orange	3	48
Red	4	64
Purple	5	80
Cobalt blue	6	96
Ultramarine	7	112
Blue	8	128
Dark blue	9	144
Blue-grey	10	160
Olive green	11	176
Green	12	192
Dark green	13	208
Orange-green	14	224
Orange	15	240

It is equally possible to jump between character sets. Two character sets are provided in ROM, but with much time and effort you could set up your own or use a character-generator program. As a character set costs only 512 or 1,024 bytes of memory, you can afford several. It is possible to switch from one to another — especially useful with characters that are not letters but shapes — or, by using Antic for machine-fast switching, use more than one character set on the screen at once. A Poke into one location is enough to switch sets.

Fine scrolling

Another interesting Atari technique using the way screen data is stored in RAM is fine scrolling. Instead of moving vast amounts of data through RAM, which is slow and difficult, on the Atari you can move the screen over RAM. As with page flipping, this is simply a matter of telling Antic the address where the screen display starts. To make it work, the RAM data must include more than a screenful of image, of course. The Atari has two registers for scrolling, one for vertical — one pixel at a time — and one for horizontal scrolling. Diagonal scrolling uses both at the same time. An interesting game called Eastern Front, 1941 by Atari's Chris Crawford provides a map about 10 screens in size — it was reviewed in June's *Practical Computing*. The player uses a joystick to fine-scroll over any of it, and the effect is remarkable. According to Crawford, the entire map program, data, display list and character-set definitions for this game use only 4K of RAM — a considerable achievement by normal standards.

Finally, the Atari has another remarkable facility called Player Missile Graphics, which allows high-speed animation. It provides four players, which can move independently of each other and the background or playfield, plus four small "missiles" — which can

(continued on next page)

mode	type	columns	rows	number of colours	bytes of RAM needed
0	text	40	24	2	993
1	text	20	24	5	513
2	text	20	12	5	261
3	graphics/text	40	24	4	273
4	graphics/text	80	48	2	537
5	graphics/text	80	48	4	1,017
6	graphics/text	160	96	2	2,025
7	graphics/text	160	96	4	3,945
8	graphics/text	320	192	1 × 2 luminances	7,900
9	graphics/text	80	192	1 × 16 luminances	8,182
10	graphics/text	80	192	9 × 1 luminance	8,182
11	graphics/text	80	192	16 × 1 luminance	8,182

Table 2. Atari 800 graphics modes and their memory requirements.

(continued from previous page)
also be combined to give a fifth player. There are collision-detection registers and priority registers, so a player can pass behind another player and in front of a third. A "player" is any graphic image you construct as long as it is not more than eight bits wide.

Once devised, the player can quickly be displayed normal width, double width or quadruple width. Each player appears as a table in RAM either 128 or 256 bytes long, depending on the degree of resolution. This table is mapped directly from the top to the bottom of the screen.

The advantage of this technique is that the player looks one-dimensional in RAM. The image can be moved up and down the table very easily and almost instantaneously. For horizontal movement there is a horizontal position register. To move the image across the screen you simply change the number stored in this register. One Poke is enough to move the whole image, even to move it off the screen. Thus high-speed graphics becomes possible.

PMG is made accessible by Antic, which is a true microprocessor with its own instruction set, program and data. It works with Pokey and the GTIA chips, each of which is almost as big, in terms of silicon area, as the 6502 itself. It is these three chips which set the Atari apart from — and, at least arguably, well above — all other 6502-based machines in terms of its ability to handle graphics displays.

The Atari 400 and 800 have a true operating system in user-removable ROM. It takes up less than 700 bytes, but also within the 10K ROM pack there are the character sets, the floating-point maths, the power-on and cartridge-select logic, and the device drivers.

The operating system is accessed through one address, so updating it, if necessary, should be straightforward. Another company already offers an enhanced operating system to go with an Extended Basic A+ for the Atari. The operating-system ROM which can be Close, Get Characters, Get Record, Put Characters, Put Record, Close, plus Get Status and Special.

There are eight device handlers in the operating-system ROM which can be assigned at will to peripherals, but will normally support four disc drives of 88K each, the keyboard, printer and screen, etc. The disc file directory can, however, take up quite a considerable proportion of the 48K RAM. There are 8K blocks of RAM where the plug-in ROM cartridges take precedence over free RAM above 32K, reducing the user memory available.

Against this, machine-language programs can be loaded without the Basic language cartridge in place. If you need large amounts of memory, you can always buy Axlon's Ramdisk which plugs into the Atari's third memory slot between two 16K packs and provides 128K in 16K addressable blocks. If you wanted to hold, say, 16 screens at once and switch quickly between them, this would be a way to do it.

Few people seem to have linked "independent" disc drives to the Atari, but Corvus has announced 5, 10 and 20Mbyte Winchesters for the 800. As the Atari operating system makes such devices easy to access, however, more can be expected.

The Basic A+ from Optimized Systems Software includes such commands as Print.Using, While-Endwhile, If-Else-Endif and some player-missile graphics commands. The Atari Program Exchange program offers extended fig-Forth and extended WSFN. Tiny-C and Logo are expected soon, while Addcom offers Lisp 2.0.

Atari computers are supplied with a book and a manual. The book is *Atari Basic*, a 340-page teach-yourself book by Albrecht, Finkel and Brown. It works by question-and-answer and is suitable for absolute beginners.

The Atari manual provides a thorough guide to setting up the machine, explains the reserved words briefly, gives a list of useful Pokes and some sample programs. However, it does not even mention player-missile graphics: for that you need the massive *Operating System User's Manual and Hardware Manual* which tells you everything you need to know and a great deal you do not.

In general, the Atari documentation is good, except in one respect — it was written for the original American machine, which had a CTIA chip instead of the GTIA one. There is thus no mention of graphics modes 9, 10 and 11. As GR. 10 allows your choice of nine colours in any luminance, and GR. 11 allows 16 colours at once, in one luminance, this is something of a loss.

Specifications

CPU: 6502C, 1.79MHz
Memory: 16K RAM, upgradable to 48K; 10K ROM operating system; 8K ROM Basic, 40-48K RAM location
VDU: not supplied; use domestic TV via built-in RF modulator or monitor via composite video output port; up to 128 colour/luminance combinations; up to 320 by 192 resolution
Sound: four-channel sound from TV speaker; keyboard sounder
Cassette: digital, 600baud plus audio channel, uses TV speaker; sold as optional extra
Power: from external transformer with two outlets, supplied with micro

Conclusions

● The Atari 800 is a smartly designed and well-finished microcomputer that plugs into a domestic TV and does not look out of place in the home.

● The keyboard and screen-editing facilities are good, and anyone used to an electric typewriter will find the 800 convenient to use.

● The books and manual supplied or available, including software, make the 800 suitable for a beginner who wants to play games and learn microcomputing. The Basic supplied is powerful and has good error-trapping, but anyone used to the Microsoft dialect will find some aspects of it idiosyncratic,

● The quality and versatility of the sound and colour graphics facilities are exceptional.

● Languages, operating systems and memory all come as plug-in ROM packs, making the 800 ultimately very versatile and capable of accepting upgrades and enhancements in the future.

● A wide range of software is available, but almost all of it is for games or educational. The arcade-style games from Atari are generally of exceptionally high quality.

● The 800 could be a suitable choice for a small business, but only if software and support become available in vastly greater quantities. An inherent limitation is that the hardware — console, discs, VDU — does not stack easily, and so requires a large area of desk space.

● It has the potential to be a very successful home computer, especially when its capabilities become more widely known. At the moment, however, both the console and the peripherals seem over-priced for the British market.

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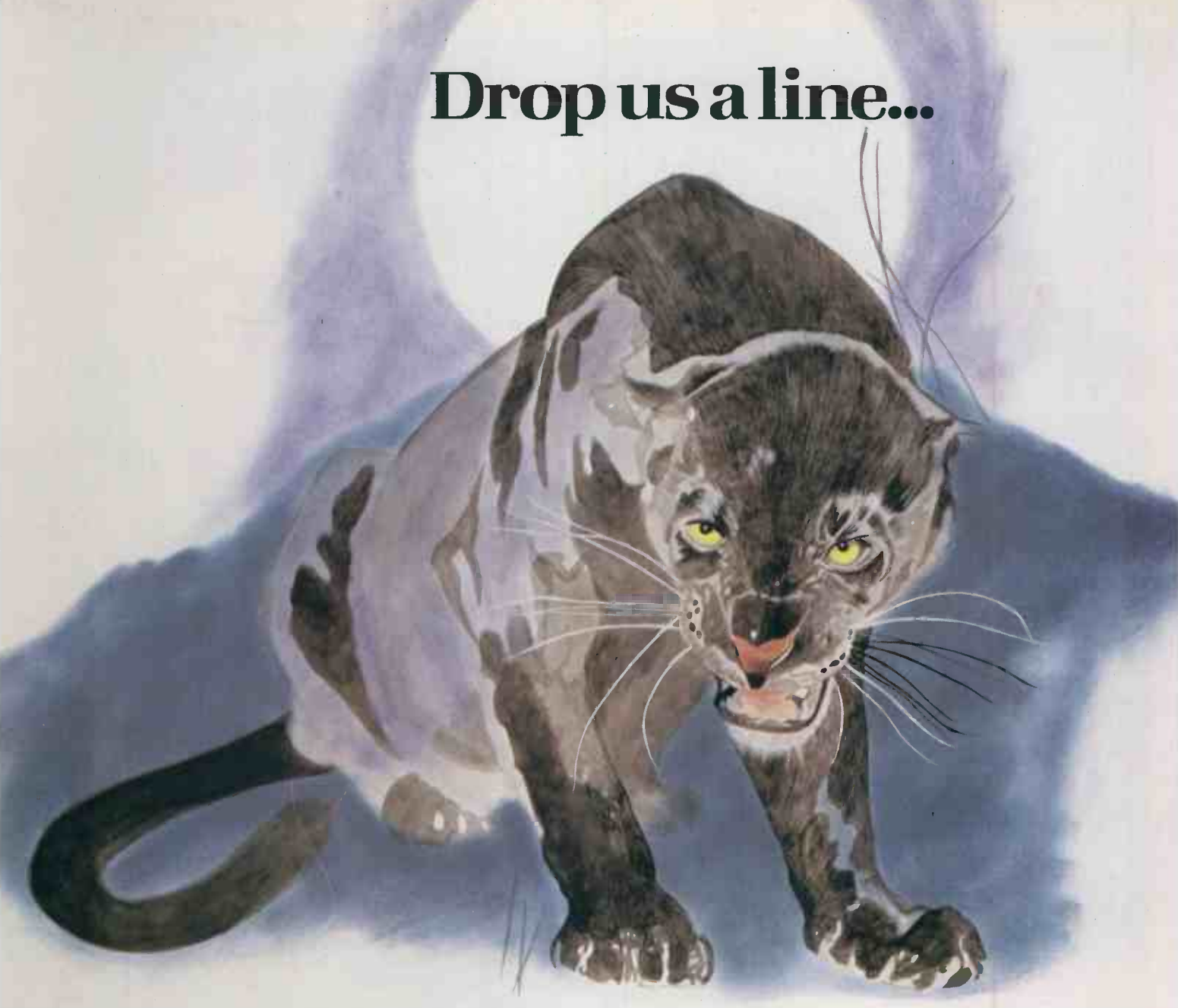

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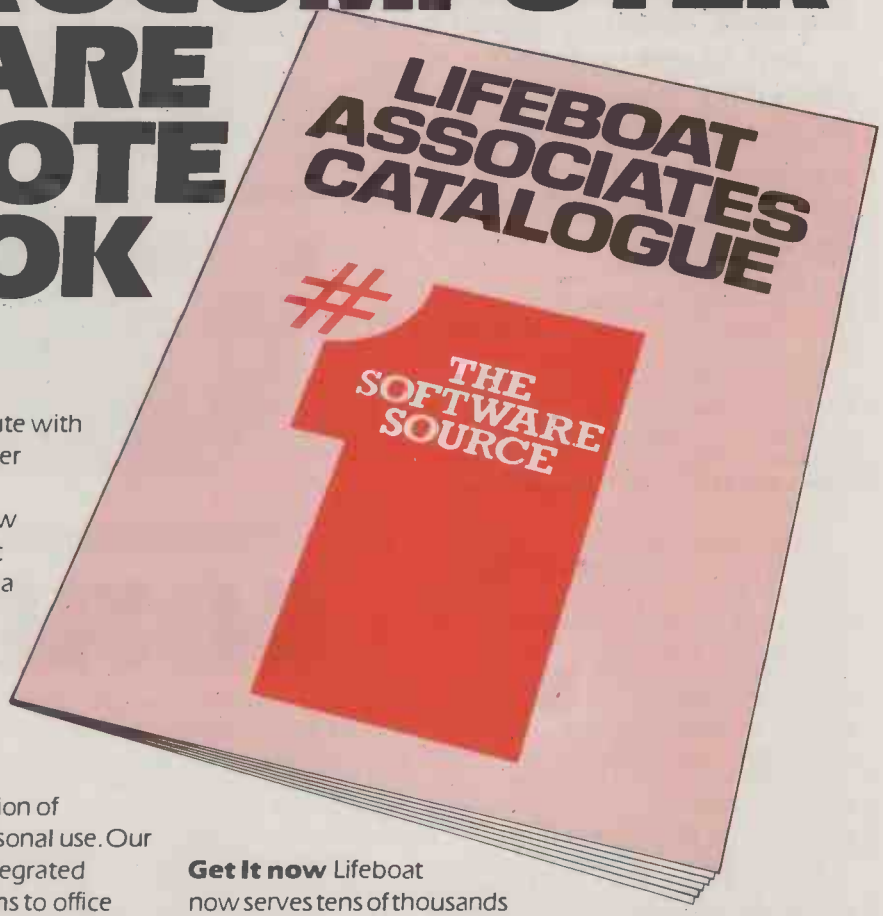
● Circle No. 154

WHEN IT COMES TO MICROCOMPUTER SOFTWARE WE WROTE THE BOOK



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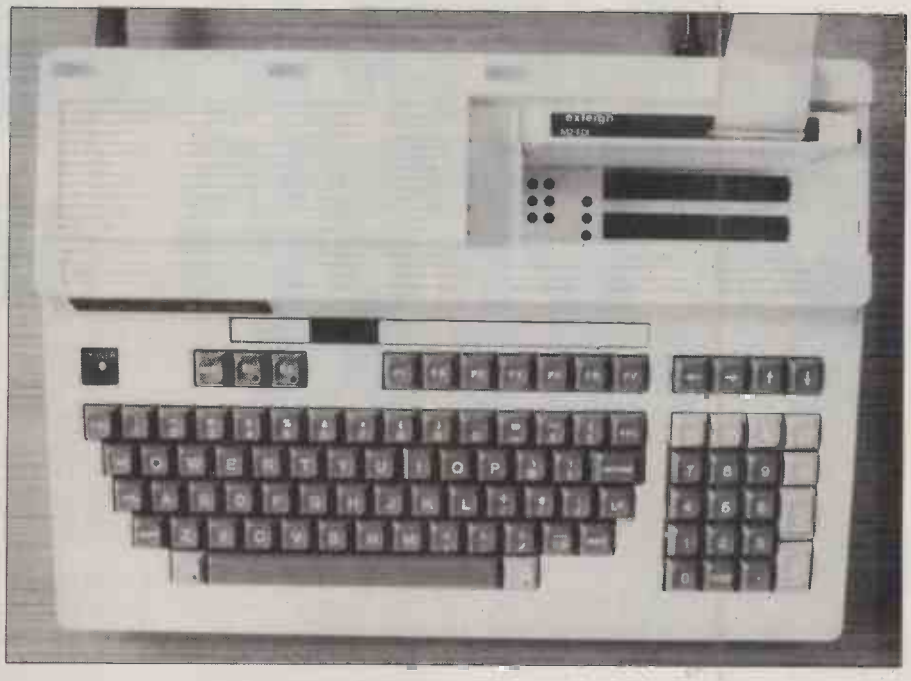
● Circle No. 155

In the Far East, Pips sells Sords like VisiCalc sells Apples — yet in Britain few have heard of Japan's second-biggest micro maker let alone its information-processing package. Ian Stobie investigates, and finds a spy in the Tab.



SORD M-23

THE USUAL eight-bit microcomputers in the £2,000 to £3,000 price bracket these days seem to be designed around a Z-80 microprocessor with CP/M. The Sord M-23 Mark III is rather different. For a start, it comes without CP/M at the moment, and the Z-80A is augmented by 128K of RAM, twice the normal memory.

The hardware approach is generally innovative, with 64K chips and four-layer PCBs employed. A liquid-crystal flat-screen display option was exhibited at the 1982 Hanover Fair.

For your £1,950 you receive three boxes, some software and a set of manuals. The intelligent part is housed in the keyboard unit and comprises a Z-80A running at the usual 4MHz, addressing 128K by adopting a page-switching approach; 4K of this is dedicated to a memory-mapped video display. A bootstrap loader lives in 4K of ROM to ensure something happens immediately you turn the system on.

Function keys

The keyboard itself is a full QWERTY layout with a separate numeric keypad, nine programmable function keys arranged in two banks, and a row of four cursor-control keys. A depression running above the function keys has space for you to label what the keys are being used for in any particular application.

The two Caps Lock keys light up when shift lock is on. Though this seems a peculiar feature at first sight it turns out to be useful when runnings Pips or if you find it necessary to ignore the screen to watch your fingers when typing. The operating system also makes use of them to signal error conditions.

The Return key is in the normal place, but with much of the Sord software you can also use the Execute key to the right of the numeric keypad, where a Cancel key is also provided. Reset is positioned well out of harm's way inside the case. You reach it with a pencil, through an opening in the right-hand side of the keyboard unit, so accidental resetting should be impossible.

Prominent on top of the keyboard unit is a well containing three expansion slots. Sord has announced various add-on units which fit in here, including a Cmos RAM cartridge, various interface cards, and ROM packs containing popular Sord software also available on disc, like Pips and the Sord Word processor. The review system had two slots free and a floppy-disc interface in the third.

The disc unit itself is a hefty 8kg. box which seems unnecessarily bulky by today's standards. It contains two Teac 5.25in. drives: they were fairly noisy, and seemed to be the kind that rotate all the time the drive doors are closed. They can be locked shut with a little lever located next to each drive door. Total disc capacity for the unit is 660K.

A 5Mbyte hard disc is promised shortly at a likely price somewhere below £2,000. Sord also markets a dual 3in. micro-floppy disc unit holding 290K each drive, but it is not yet being imported into the U.K.

The third box is a 12in. monochrome video monitor with green screen, the same unit which is sold independently under the BMC brand name in the U.K. It displays 25 lines by 80 characters of text, with each alphanumeric or graphic character constructed from an eight-by-eight matrix; it lacks true descenders.

The standard Sord generates an RGB colour-video signal, so if you attach an optional colour monitor it gives you an eight-colour display. Colour can be specified character by character, so you can display mixed-colour text and graphics. The colour capability is made use of in Sord-supplied software like Pips.

By judicious choice of graphics characters 640-by-200 point high-resolution graphics are achievable. For precision graphics Sord provides Sord Graphics Language as an option, which has high-level commands to plot points, draw arcs, construct bar diagrams and so on. The display is average for a machine of this class, though inferior to new generation 16-bit micros like the ACT Sirius, which is not much more expensive.

Two RS-232C sockets are provided, one configured in Modem and the other in Teletype mode. There is also a parallel Centronics-type socket, so most makes of printer should be compatible. We were using an Epson MX-80F/T which costs about £360 at the moment and worked perfectly with the system. Exleigh can supply character-set ROMs for it if you particularly want Pips graphics to appear the same on the printer as on the screen.

LCD add-on

The most interesting add-on for the Sord M-23 Mark III is the liquid crystal display which can display eight lines of 80 characters, using an eight-by-eight matrix of LCD dots. Clearly this is a first step towards 24 lines and ultimately 66-line full-screen displays. An LCD display is compact, flat and uses reflected light, and so promises to be a more natural analogue to paper than a cathode-ray tube.

The software normally provided is SOS, the Sord Operating System, CBasic — not Digital Research's offering of the same name but Sord's compiled Basic — and Pips II, the latest version of Sord's spread-sheet and record-handling package. We also took a look at the Sord word processor which would normally be extra.

Other languages available are UCSD Pascal, Fortran 80 and Cobol 80, which have been configured to run under SOS, and Sord DBasic — "D" stands for Docking Basic, because it can link up with PIPS files. Sord terminology

sometimes shows traces of hours spent at the Space Invader machine.

CP/M is not available yet but is promised. As a non-CP/M machine the M23 Mark III does suffer from a relative lack of software. A number of application packages are available from Exleigh for specific types of user, including video hire, building job costing and accounts, mailing, and the standard accounting applications.

Expansion possibilities

The M-23 Mark III is really the start-level business system aimed especially at people interested in running Pips. Other machines in the Sord range are larger and have greater expansion possibilities including S-100 bus slots, more disc options and a different keyboard.

On switching on the system a message comes up on the screen telling you to SET DISKETTE AND STRIKE ANY KEY. Doing this boots the resident part of the operating system off the disc and it then announces itself with another message and a request for the current date. Any errors during this process are indicated by the built-in speaker sounding and the lights on the Caps Lock keys coming on. After entering the date you can start running programs, copying discs and using any other operating-system functions.

The operating system will seem familiar enough to users of CP/M. It is simple and straightforward, and in general its activities are accompanied by helpful messages. Direct and sequential file-access methods are supported. The SOS manual is short but detailed, which is a relief after the scrappy documents with separate amendment pages that come with some CP/M systems. However it could do with an index, the absence of which is a common failing with Sord documentation.

After entering the date, every operating system command can be entered as a single keystroke of the function keys, so only one person needs to understand the system in any depth and can set it up for others to use simply. Function-definitions live on disc, so you could work with one disc per application with the function keys set up for the jobs involved. An individual program might also use the function keys for different purposes, in which case they would return to their operating-system functions when control passed back to SOS on exiting the program.

The seven keys can be used shifted or unshifted, giving 14 definitions which can each be up to 31 characters long and consist of any valid SOS commands. So the first three keys could be set up as follows:

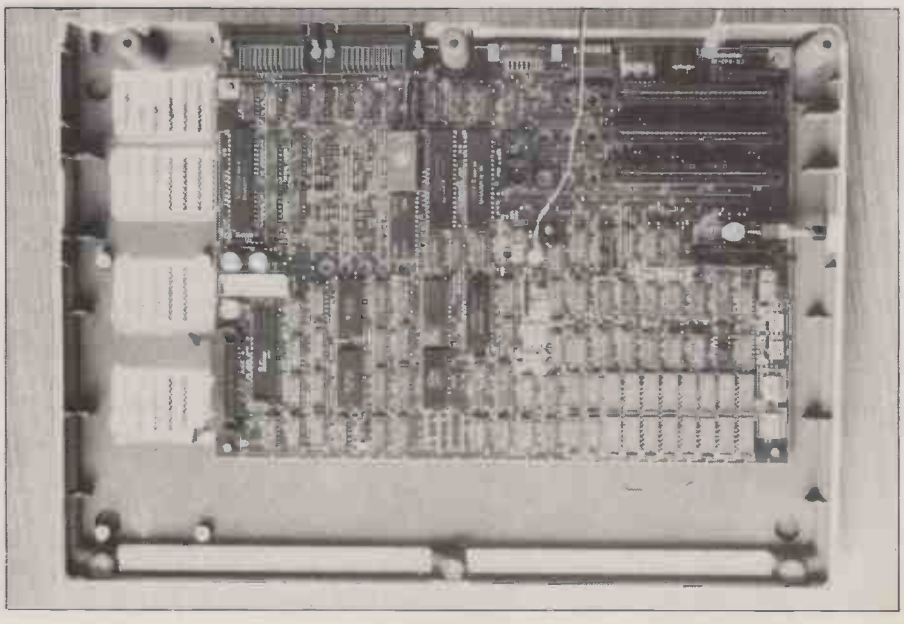
F1: BASIC/C RUN'UPDATE <CR>
F2: XFER O:PRICES 1:PRICES
F3: LIST/1

This means that after booting and entering the date, hitting F1 will load Basic and run the program Update; F2 will make a backup copy of the file Prices, copying it from drive 0 to drive 1; F3 will list the names of the files on disc 1 — List here is the SOS equivalent of Catalog or Directory.

A similar procedure allows the system to be set up to operate in true turnkey mode, with control passing directly to a program as soon as a disc is booted, without any conversation about the date.

The Sord word processor is quite a professional piece of software. Users familiar with WordStar will find it does formatting differently, with a format line displayed at the top of every screen into which formatting parameters like line spacing, line length and tab positions are entered. You then type in text page by page.

The M-23's main board is a compact four-layer PCB. The CPU is a Z-80A at top left, with the 64K RAM in the 16 chips at bottom right.



Specifications

Microprocessor: Z-80A running at 4MHz
Memory: 128K in two banks; 64K in bank 0, 60K plus 4K dedicated to the screen display in bank 1
ROM: 4K boot
Ports: Two RS-232C serial; one parallel; black-and-white video, colour video
Screen: Monochrome 12in. green, or optional colour monitor; 80 characters by 25 lines; Characters formed from five by seven dots within eight-by-eight dot matrix. graphics character set gives effective 640 by 200 resolution
Keyboard: Full ASCII set in QWERTY layout; separate numeric pad; cursor-control keys; seven programmable function keys and two special keys
Bus: Sord M2; three user-expansion slots
Discs: Two Teac FD-50C drives, 320K each, using standard 5.25in. floppy discs
Software included in price: SOS, CBasic, Pips II
Other languages available: Z-80 assembler; DBasic, interfaces to Pips; UCSD Pascal; Fortran; Cobol
Price: £1,950
U.K. importer: Exleigh Business Machines, 11 Market Place, Penzance, Cornwall TR18 2JB. Telephone (0736) 66577

The method used to insert and delete characters is clear, but slow for individual characters. After hitting the Insert function key the screen is rearranged to display the 40 characters following the cursor at the bottom of the screen. You then type in the new material and hit Execute, and the screen is redisplayed with the insertion made. For correcting gross typing errors like mis-struck keys this is a lengthy process for one character: the approach is clearly aimed at the skilled copy typist doing cut and paste work on a standard document.

Delete, Move, Copy and Replace are done in a similar way. Here you move the cursor from the position it was in when you hit the function key to the end of the range of text — the scope — you wish to deal with and the relevant text is displayed in reverse.

Word processor

The word processor includes a merge function, useful in producing a batch of standard letters with name, address, salutation and discount rate personalised. It is straightforward to use, but has the limitation that the fields of the separate merge file have to be in the order you intend to use them in the letter. You cannot hold the telephone number immediately after the address and then print a letter where the telephone number appears first.

Housekeeping functions have not been neglected. Information is kept on when a file was last revised, printed and backed

(continued on next page)

(continued from previous page)

up. The taking of back-up copies is encouraged by display of archive functions on a screen menu; you can duplicate your back-up disc or archive file as a print image with all formatting parameters saved as well.

This attention to gathering statistics extends to the word processor counting your keystrokes as you type and filing away the number of keystrokes against the time taken. Since the Sord automatically repeats a key if it is held down for more than half a second the obvious way to defeat this spy in the micro is to hold down the space bar on some innocuous part of the document while conducting discussions with your friends. Subsequent deletion of the space page makes no difference to the statistics held. Obviously the designers of this package do not rate the ingenuity of its ultimate users very highly.

A more useful feature the package boasts is the glossary, which allows you to define a commonly occuring phrase of up to 77 characters and equate it with one of the ordinary keys on the keyboard. The phrase can later be recalled and inserted into the text simply by hitting the function key F7 followed by the relevant key. The number of keys on the keyboard imposes a limit on the size of the glossary.

The word processor manual lacked an index. A reasonably clear and detailed manual describes a version of the system running on the larger Sord machines, while a scrappy modification document describes all the differences. You need to use this to find what each function key does as the M-23 keyboard is quite different.

Pips

Much of Sord's expansion in Japan has been based on the success of Pips, which sells Sords like VisiCalc sells Apples. In addition to spread-sheet features, like VisiCalc Pips can also be used as a report generator or record-card manager, having sort and search facilities and being able to handle non-tabular data.

Two Pips manuals were provided, of which one covers the system badly and the other well. The good one is very clear and easy to follow but has no index.

To use Pips you place the Pips program disc and the Pips data disc in the drives and boot in the normal way. After entering the date the screen displays an example of a Pips page and a message asking you to select a command.

Pips operates on screenfuls of data, termed pages, which can consist of either tabular data formatted into rows or columns, or unformatted data consisting simply of text or graphic characters. Significantly, data on either kind of page can be retrieved by the search command.

A typical sequence of Pips commands might read:

```
G<CR>
15<CR>
L<CR>
```

Hitting G followed by carriage return instructs Pips to get a page; Pips then asks which page. Typing 15 causes Pips to fetch page 15 on to the screen from the disc. Typing L lists it on the printer.

Sequential commands

Pips derives its power from its ability to handle sequences of commands. Commands can simply be entered in a line separated by semicolons:

```
G;15;L
```

gets page 15 again and lists it. More powerfully, a command line can be stored on disc and equated with a function key. Hitting that key when the system is expecting a Pips command will then execute what is, in effect, a small program. The procedure to do this is very simple:

```
PF;7;G;15;L
```

allows you to use function key 7 to do the listing of page 15 in future.

Although these sequences of commands look unreadable, constructing them is made easy by the ability to review the last 10 command lines you have given to Pips. So you can experiment until everything is right, then copy the successful line on to a function key.

Here is another program, this time operating on tabular data:

```
CAL;C5-C3=;FO;C;W;4
```

CAL;C5 – C3= calculates the difference between the figures in column 5 and column 3, for all the figures in the column. The results go into a work area. FO;C brings the results back as a column of figures; and W;4 writes them into column 4. You could equally well create a new column, say 6, or set up a new page for the results.

Longer sequences of commands can be stored as named programs. Instead of pressing a function key the command Au#Name is entered. Pips includes a small program editor.

The latest version of Pips, supplied for review, goes beyond this to include a complete programming language called Inp. It resembles a simplified Basic but can operate on Pips pages, as well as providing other ways of organising data. Sord's Basic, DBasic is available for really complex applications.

The significance of these features is that Sord has provided not just a spreadsheet package but a graduated introduction to data processing. Data set up casually with Pips can end up being reorganised and used as part of an integrated suite of Basic programs. If you are not ready for this level of sophistication you can just use Pips as a screen-based worksheet for calculations, using single commands if you like.

VisiCalc is the obvious benchmark with which to compare Pips although the design approach is very different. With both you have the convenience of being able to type in data before you have decided what you are going to do with it, and then deciding how you want to manipulate it.

In VisiCalc, formulae are entered into the cells of the table in the same way as data. This is spontaneous, but it is easy to overwrite a carefully constructed formula without realising it. Pips commands are kept more securely, so it can safely be used by unskilled staff doing a regular job set up by someone else. Sord has again used the function keys effectively, and by providing for named programs makes very long sequences of commands much easier to carry out than would be the case with VisiCalc.

With Pips, results can be put into new tables as well as inserted into new columns in existing tables. Unlike VisiCalc, columns can have different widths and these can be changed independently after data has been entered. Pips can draw bar graphs and simple dot graphs, and handles upper- and lower-case text. With a colour monitor it can do graphs in eight colours.

Pips can operate on unformatted pages of text as well as tabular data. String searches work on both. Its files interface easily to Sord's DBasic.

Sord has grown rapidly in its native Japan to take 17 percent of the personal computer market, placing it second only to NEC. But in Europe it is a relatively unknown company outside Ireland, where it is building a new plant.

Sord machines are available in England through Exleigh Business Machines of Penzance, Cornwall: the M-23 Mark III is marketed as the Exleigh Expert X6-22. Exleigh has a network of 24 dealers selling mostly into the small business sector with appropriate application software.

Conclusions

● A generally well-made, relatively modern and expandable machine. At just under £2,000 it is good value.

● If you can find suitable software there is no need to have any qualms about the Sord hardware. However, as long as CP/M is not available you are less likely to find something that fits your needs. Otherwise the Sord SOS is quite adequate.

● Distinctive hardware features like the function keys and colour graphics are well supported by the Sord system software. Some effort has been devoted to making the hardware features usable.

● The ergonomics of the keyboard and screen, though quite good, are not up to the standard set by the very latest and generally slightly more expensive machines from major manufacturers. It is worth taking a look at machines like the ACT Sirius, IBM Personal Computer and DEC Rainbow 100 to see how much these things matter to you.

● Pips is very good. It is quite likely that many people will use the machine simply as a Pips engine, as in Japan.

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INSIGHT VDT-6
A new, stylishly designed terminal for use with 'WORDSTAR', it features 31 special Wordstar function keys for higher performance word processing. 80 character x 24 line display with an enhanced contrast screen. Graphic line drawing mode. Detached keyboard with numeric pad. Full video attributes e.g. underline, reverse video, blinking. 16 independent baud rates for interfacing. The most competitively priced Wordstar VDU on the market.

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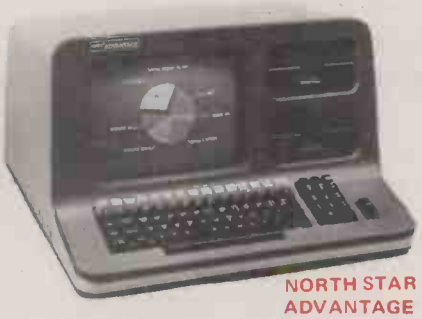

NORTH STAR ADVANTAGE
North Star's latest desk top computer. The Advantage is an integrated graphics computer that is equally suited to both business and scientific use. Advanced features include dual processors, and high resolution graphics display. The Advantage contains a 4 MHz Z80A CPU with 64Kb of 200 nsec dynamic RAM (with parity) for program storage, a separate 20Kb 200 nsec RAM to drive the bit-mapped display, a 2Kb bootstrap PROM and an auxilliary Intel 8035 microprocessor to control the keyboard and floppy disks. The two integrated mini-floppy drives are double-sided, double-density providing storage of 360Kb per drive for a total of 720Kb. Inside the chasis is a eight slot mini-bus for plug-in option cards. Included with the Advantage system is a system diskette containing a Business Graphics package, a complete system diagnostic program and a graphics demo. package. The serial printer port is graphics software compatible with Epson printers, making it easy to produce a hardcopy of the screen. For a wide variety of commercial, scientific or industrial applications North Star's graphics version of the industry standard CP/M is offered.

NORTH STAR HORIZON HARD DISK
The highly regarded Horizon microcomputer with mini-winchester disk drive. This integral hard disk gives a massive 3, 6, 9, or 12 million character storage capacity. More intensive computing power sufficient for virtually all applications. For further capacity, up to four M26 Winchester hard disks can be added externally giving access to over an incredible 100 million characters of data. Using Starlink our enhanced CP/M compatible multi-user operating system this data can be accessed by one or more users in a time sharing or multi-processing environment. Starlink is at the heart of system expansion. Starlink logically integrates the Horizon with a range of Winchester disks and/or additional I/O, memory and processors. Features include independent login and logout, print spooling, file lock and unlock for common files, five priority levels, two-way private communications, mail/news/message facilities etc. In all over 20 utilities are incorporated in the Starlink package.

EPSON MX82 F/T
A first class compact dot-matrix printer with high resolution bit image graphics. Bi-directional logic seeking printing, 80 cps, quiet operation. Plotter printing.

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Low cost fully intelligent terminal with many features as standard normally found as options on similar priced terminals. Typewriter tabs, monitor modes, programming features. 8 x 10 character resolution. Full video attributes. 15 baud rates.

RICOH RP1600S
Fast and reliable making it suitable for todays word processing demands. Its heavy duty construction will stand up in harsh working environments. Bi-directional, logic seeking, 65 cps. Options include Tractor feed, automatic sheet feeder.

How would a matrix printer costing £850 sell?

Alps ASP 3500 matrix printer is a high speed bi-directional printer capable of up to 180 characters per second output. Compact and lightweight, it contains four languages as standard character set and is available in two versions: A with 7x9 matrix for business use, giving a true descender; and B with 9x9 matrix for graphics work.

Printing flexibility is what this machine understands best. With a maximum of 181 kinds of character patterns, the ASP-3500 can handle British and American English, German and French. Variable print capability permits 10 cpi for normal characters, 5 cpi, 6 cpi, and 8.25 cpi for elongated characters, and 12 cpi and 16.5 cpi for compressed characters. Easily adjustable forms tractor mechanism allows you to use any size standard pin feed form, from 5 inches to 16 inches.

Precision wire heads can pound-out up to two hundred million maintenance-free characters. Heads come in two types, and are replaceable in the field, keeping costly down-time to a minimum.

The ASP-3500 with its ease of operation, light weight, compact size and quiet operation make it welcome in any office environment. It features a standard systems self-test capability for maintenance ease. Heavy duty ribbon cartridge pops in, pops out, for clean, quick ribbon replacement. RS-232C standard interface, 20mA current loop or industrial standard parallel interface are also available.

If you're interested in distributing Alps 3500 in the UK, give us a call – at only £850 we think they'll sell like hot cakes!

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Tel: 01-397 5111.
Telex: 929929 Mitmac G.

Alps is already available in the UK from:
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A1 PERIPHERALS
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AWS LTD
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COMPUTER SYSTEMS WESTERN
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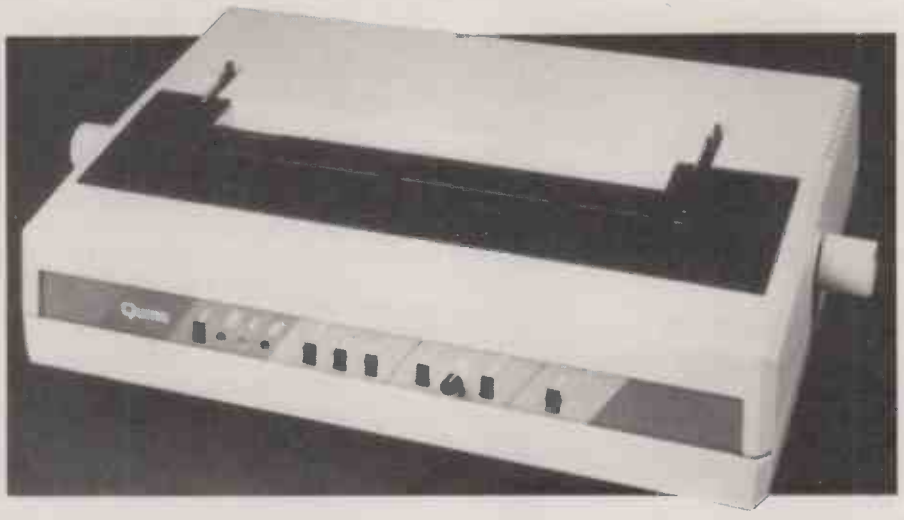
ALPS ASP3500 MATRIX PRINTER

MITSUI COMPUTERS

● Circle No. 160

QUME SPRINT 9



Chris Bidmead reports on the latest daisywheel unit from the United States.

THE FEATURES OFFERED by the new Qume Sprint 9 are excellent, the mechanism scored very highly during the course of our tests, but the appearance of a piece of office equipment also has to be lived with. In that respect the Qume is less than a total delight.

The weighty detailing of its squared-off cream-coloured fibre-resin case could be described as "New Brutalist". This looks fine on the Pentel pen, where an elegant designer's joke lies in the tension between heavy styling and small dimensions. Blown up to the size of a piece of office equipment "New Brutalism" only makes the Qume Sprint 9 look out of proportion.

Designed for price

The heavy look of the Japanese pen is offset by superb mass-production engineering, which saves it from being clumsy. The new Qume printer terminal, on the other hand, like many recent U.S. products, appears to be built down to a price.

The top half-cover of the case, for instance, is designed to hinge up for ribbon-changing and so forth, but if the forms tractor is fitted there is not sufficent space. Space could have been made by cutting a rather larger well in the cover, as on the Ricoh, but part of the Qume designer's brief was evidently to reduce sound to a minimum, implying an enveloping cover no matter what other penalties that implied.

The compromise solution is to loosen a couple of small bolts, disconnecting the cover from the hinges, and slide forward some small lugs before the bolts are retightened. The top half-cover becomes independent of the rest of the case, and clips into position under the lugs when the forms tractor is in position.

New cartridge

On the review model a small blade jutting out from beneath the cover often failed to engage with the cover-off switch. Frequent access to the print-head is necessary during a review so we had to jury-rig the cover-off switch with a stout paper-clip.

This gave us a clear view of the printer mechanism, which is the most interesting aspect of the machine. Qume has at last followed the Diablo lead in providing a new Mark IV cartridge that can be changed without fingers touching the ribbon. Qume's cartridge replacement is the easiest of any machine reviewed so far. You should be able to do it single-handed, if the span of your hand is broad enough to press down the red lugs that click the cartridge in on either side. Also mounted on the ribbon cartridge is a photoelectric cell for detecting ribbon-out.

Replacement of the daisywheel is again the easiest we have seen — simply a matter of unlatching a spring-loaded lever to the right of the print hammer and pulling the wheel-mount backwards. Unlike some other printers the wheel-mount is independent of the cartridge carriage, and can thus be moved back as much as 90 degrees.

Unusually the ribbon cartridge platform is made of ABS plastic, part of the cost-paring exercise evident throughout the machine. This component would not articulate to allow printing of two-colour ribbon, and indeed the manual mentions no escape code sequences to permit this. Yet the ribbon in the cartridges is 8 mm. thick — sufficient to allow one track of each colour. Alternatively IBM golf-ball typewriters use an automatic shift mechanism to arranges that the keys impact in turn across the whole width of the ribbon.

The Qume incorporates no such arrangement, which means that every used cartridge goes to the bin with a whole character-width track of ribbon unused. It is not hard to deduce from this that later versions of the Sprint 9 will incorporate some kind of vertical articlation between the wheel and the cartridge platform.

One of the cartridges jammed and had to be discarded because of uneven winding on the take-up spool. The absence of lubrication washers — the flimsy plastic discs that separate the rotating coil of the ribbon from the interior of the cartridge case may have had something to do with this. The ribbon cartridge is manufactured from fewer parts than we are used to seeing. It is unfair to make sweeping deductions from one ribbon jam, but it did raise doubts that Qume may be skimping too much here.

The print-head drive mechanism has been redesigned. Lateral movement is now powered by a corrugated synthetic belt direct from the motor housed in the front right-hand corner of the chassis. The belt looks familiar but Qume claims that its belt is new, special, unique, and made out of Kevlar, not just a rehash of a similar idea long used on dot-matrix printers.

Drive band

This drive band seemed remarkably elastic in comparison with the usual steel cables; but perhaps the lightness of the print head that Qume has been able to achieve makes this new arrangement possible. The whole print-head rides on a pair of conventional steel bars, sliding on bushed cylindrical jackets. There are no rolling wheels as in conventional printers; presumably the low inertia of the print-head helps reduce friction to a point where moving bearings are unnecessary.

The mechanism could hardly be simpler in conception, yet our tests show that precision of printhead positioning is second only to the Diablo. The whole printer chassis is mounted on rubber shock absorbers, which help account for the remarkable quietness of the machine. Qume call the mechanism Microdrive, and it works very well. It is also cheaper to manufacture, which must help during a recession.

Manufacturers still produce machines that have to be stripped down to get to the configuration switches that match the printer protocols to the host computer's expectations. The Qume Sprint 9 thankfully makes these available on the right-hand side of the front panel, easily accessible with the front cover removed.

(continued on next page)

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In addition to these two eight-element DIL switches, the front panel includes seven rocker switches for reset, line space, pitch, word processing — an option not provided on the review machine, set top of form, form feed and pause. Other features are a rotating knob for manually setting the form length and three lights for carrier detect (green), ready (amber) and communication error (red). The ready light has three modes. Slow flashing indicates paper out, fast flashing indicates top cover off or ribbon-out error.

Rocker switches

The switches are the rockers now abandoned by Diablo in favour of pressure-sensitive contacts. These and the other front-panel components are mounted on an aluminium chassis decorated with rather unnecessary go-faster diagonal stripes.

The whole front-panel unit connects through a screened ribbon cable to the main electronics, and is held to the chassis with four screws, so that it can truly be described as modular, the only other connection being an earth strap. A version is available without this front-panel — with similar configuration facilities requiring access to the boards — for £100 less.

The rear half of the top case is held on by two long bolts and a short captive bolt at the rear, which only requires a quarter turn to release it. It seems a pity that the two long bolts are not captive too. It also seems old-fashioned that this top cover is not immediately removable: the photo-electric paper-out switch which clips somewhat uncertainly on to the top case has to be disconnected.

It is awkward to get off when removing the rear cover, and in use it also doubles as the paper left-edge locator, but for this purpose it really will not slide with the proper positive action. This part of the mechanism is carried over from the Sprint 5 range; we understand that the latest production models of the Sprint 9 range have a better-designed version.

Efficient cooling

The main boards are housed inside a rugged utilitarian metal box at the rear of the chassis. The fan is set into this box, and the arrangement looks as if it might greatly improve cooling efficiency. Five bolts have to be unloosened to remove the box, and this reveals three ordinary printed-circuit boards and the power pack, which is made up of rather heavier components sandwiched between a pair of boards. This is a great improvement on the power pack of the Sprint 5 series, which was a bulky module bolted on to the rear of the chassis.

Though stylistically integrated, the Sprint 5 power pack was always rather vulnerable physically, particularly if you succumbed to the temptation to upend the machine on it during transportation or servicing. Like the Ricoh, the new Qume can be comfortably stood on end.

Straightforward removal

The processor chip on the main logic board is the speedy eight-bit Intel 8085A. The three PCBs and the power pack slot into a motherboard mounted horizontally to the bottom of the chassis, and have edge levers to enable easy removal. There are no fiddly connectors to be unhooked before removing the single boards, and extracting the power pack board is only very slightly more complicated, with two connectors, one to the fan and one to the mains switch.

As a result the electronics section is truly modular, and any or all of the boards could easily be replaced in about 10 minutes — plus the time you spend scrabbling about on the floor to find the two bolts that flew out when you removed the top cover.

Handshaking options are: ETX/ACK and DTR; or XON/XOFF. Qume has its own user-friendly way of managing escape sequences, but the Diablo versions are also there waiting to be called if your software prefers them. For example, Define Vertical Spacing Increment the Qume way is to send ESC "L" and then two ASCII digits which spell out the number of ¼₈in. increments required between lines. The Diablo way of doing this is to send ESC RS and then a single ASCII character, the binary value of which is one more than the number of required increments. The former is easier to send manually, the latter easier to program for if you are writing in assembler.

ISG Data Sales Ltd, the Windsor Qume distributor which kindly lent us the machine, was not able to provide the matching Qume sheet feeder at the time of review, but it should be available shortly. It is driven by a separate power pack and is fully interchangeable between the Sprint 9 and the Sprint 5.

Test	time taken	comments
Standard text	1m. 31s.	About 43 cps, eight percent slower than the Flowriter, but faster than the Diablo 630.
Formatted text	46s. 48s.	Healthy speed; close to the Ricoh, the fastest machine we have reviewed so far
Tabbing	46s.	Good alignment, but not up to the Diablo 630. Oddly enough, it took longer than the Diablo, too.
Graphics	3m. 30s.	40s. faster than the Diablo, much slower than the Ricoh. Good impression control.

For a description of these tests see the Diablo 630 review in the March 1981 *Practical Computing*.

Formatted text test. At last a machine whose tested speed is within a reasonable margin of the claimed speed. Qume declares the conditions of its test, the single line printing of a touching vignette that goes: "We sat there at noon on the corner bench in the railroad station and ate oranges while we waited. When the train came, we went home".

Tabbing test. A little disappointing, this one. Tabbing to the vertical bar character is not a test daisywheel printers enjoy, and of those so far reviewed only the Diablo 630 emerged with any distinction. The Qume was quite high up in the alignment quality league tables, but the slow speed was surprising, suggesting that the software may have been slugged to cope with the very low inertia of the print head, perhaps coupled with the elasticity of the Kevlar drive belt.

Graphics test. This test uses asterisks, full stops, underlines and angle brackets to produce a rather silly wallpaper pattern that fills half an A4 sheet. The Sprint 9 did this faster than the Diablo, the Spinwriter and the Flowriter, but is beaten by the Ricoh parallel version at 3m. 30s.

Conclusions

● The Qume Sprint 9 is not a particularly fast machine — we reviewed the slower of the two available models — but impression control is excellent, and character alignment is good.

● The print mechanism is noticeably quieter than the average daisywheel machine, important in a shared office. We know of one office where the printer — not a Qume — has been confined to a large cardboard box filled with packing material. It gets warm in there.

● Despite some hermetic chat about ballistics from the manufacturers it has been our experience that Qume and Diablo plastic non-proportional, that is ordinary, printwheels are interchangeable. Second sources of the wheels are also available. You may feel this adds up to an important advantage over Japanese departures like Spinwriter and Ricoh.

● The very high standards of electronic and mechanical design established at the drawing-board stage may not have been entirely carried through to the factory.

● Qume Sprint 9 — 45cps version, as reviewed £1,725.00
Qume Sprint 9 — 55cps version £1,795.00
Mark IV Ribbons, box of 12 £50.00
Printwheels, each £6.00

Either version is available without the front panel for approximately £100 less. A front panel should not be necessary if the machine is to be a permanent attachment to a single host computer.

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New ZX81 Software from Sinclair.

A whole new range of software for the Sinclair ZX81 Personal Computer is now available – direct from Sinclair. Produced by ICL and Psion, these really excellent cassettes cover games, education, and business/household management.

Some of the more elaborate programs can only be run on a ZX81 augmented by the ZX 16K RAM pack. (The description of each cassette makes it clear what hardware is required.) The RAM pack provides 16-times more memory in one complete module, and simply plugs into the rear of a ZX81. And the price has just been dramatically reduced to only £29.95.

The Sinclair ZX Printer offer full alphanumerics and highly-sophisticated graphics. A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. So now you can print out your results for a permanent record. The ZX Printer plugs into the rear of your ZX81, and you can connect a RAM pack as well.

Games

Cassette G1: Super Programs 1 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Invasion from Jupiter. Skittles. Magic Square. Doodle. Kim. Liquid Capacity.
Description – Five games programs plus easy conversion between pints/gallons and litres.

Cassette G2: Super Programs 2 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Rings around Saturn. Secret Code. Mindboggling. Silhouette. Memory Test. Metric conversion.
Description – Five games plus easy conversion between inches/feet/yards and centimetres/metres.

Cassette G3: Super Programs 3 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Train Race. Challenge. Secret Message. Mind that Meteor. Character Doodle. Currency Conversion.
Description – Fives games plus currency conversion at will – for example, dollars to pounds.

Cassette G4: Super Programs 4 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Down Under. Submarines. Doodling with Graphics. The Invisible Invader. Reaction. Petrol.
Description – Five games plus easy conversion between miles per gallon and European fuel consumption figures.

Cassette G5: Super Programs 5 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Martian Knock Out. Graffiti. Find the Mate. Labyrinth. Drop a Brick. Continental.
Description – Five games plus easy conversion between English and continental dress sizes.

Cassette G6: Super Programs 6 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Galactic Invasion, Journey into Danger. Create. Nine Hole Golf. Solitaire. Daylight Robbery.
Description – Six games making full use of the ZX81's moving graphics capability.

Cassette G7: Super Programs 7 (ICL)
Hardware required – ZX81.
Price: – £4.95.
Programs – Racetrack. Chase. NIM. Tower of Hanoi. Docking the Spaceship. Golf.
Description – Six games including the fascinating Tower of Hanoi problem.

Cassette G8: Super Programs 8 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Star Trail (plus blank tape on side 2).
Description – Can you, as Captain Church of the UK spaceship Endeavour, rid the galaxy of the Klingon menace?

Cassette G9: Biorhythms (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – What are Biorhythms? Your Biohythms.
Description – When will you be at your peak (and trough) physically, emotionally, and intellectually?

Cassette G10: Backgammon (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Programs – Backgammon. Dice.
Description – A great program, using fast and efficient machine code, with graphics board, rolling dice, and doubling dice. The dice program can be used for any dice game.

Cassette G11: Chess (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Chess, Chess Clock.
Description – Fast, efficient machine code, a graphic display of the board and pieces, plus six levels of ability, combine to make this one of the best chess programs available. The Chess Clock program can be used at any time.

Cassette G12: Fantasy Games (Psion)
Hardware required – ZX81 (or ZX80 with 8K BASIC ROM) + 16K RAM.
Price – £4.75.
Programs – Perilous Swamp. Sorcerer's Island.
Description – Perilous Swamp: rescue a beautiful princess from the evil wizard. Sorcerer's Island: you're marooned. To escape, you'll probably need the help of the Grand Sorcerer.

Cassette G13: Space Raiders and Bomber (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £3.95.
Programs – Space Raiders. Bomber.
Description – Space Raiders is the ZX81 version of the popular pub game. Bomber: destroy a city before you hit a sky-scraper.

Cassette G14: Flight Simulation (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Program – Flight Simulation (plus blank tape on side 2).
Description – Simulates a highly manoeuvrable light aircraft with full controls, instrumentation, a view through the cockpit window, and navigational aids. Happy landings!

Education

Cassette E1: Fun to Learn series – English Literature 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Novelists. Authors.
Description – Who wrote 'Robinson Crusoe'? Which novelist do you associate with Father Brown?

Cassette E2: Fun to Learn series – English Literature 2 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Poets, Playwrights. Modern Authors.
Description – Who wrote 'Song of the Shirt'? Which playwright also played cricket for England?

Cassette E3: Fun to Learn series – Geography 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Towns in England and Wales. Countries and Capitals of Europe.
Description – The computer shows you a map and a list of towns. You locate the towns correctly. Or the computer challenges you to name a pinpointed location.

Cassette E4: Fun to Learn series – History 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Events in British History. British Monarchs.
Description – From 1066 to 1981, find out when important events occurred. Recognise monarchs in an identity parade.

Cassette E5: Fun to Learn series – Mathematics 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Addition/Subtraction. Multiplication/Division.
Description – Questions and answers on basic mathematics at different levels of difficulty.

Cassette E6: Fun to Learn series – Music 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Composers. Musicians.
Description – Which instrument does James Galway play? Who composed 'Peter Grimes'?

Cassette E7: Fun to Learn series – Inventions 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Inventions before 1850. Inventions since 1850.
Description – Who invented television? What was the 'dangerous Lucifer'?

Cassette E8: Fun to Learn series – Spelling 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Series A1-A15. Series B1-B15.
Description – Listen to the word spoken on your tape recorder, then spell it out on your ZX81. 300 words in total suitable for 6-11 year olds.

Business/household

Cassette B1: The Collector's Pack (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Collector's Pack, plus blank tape or side 2 for program/data storage.
Description – This comprehensive program should allow collectors (of stamps, coins etc.) to hold up to 400 records of up to 6 different items on one cassette. Keep your records up to date and sorted into order.

Cassette B2: The Club Record Controller (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Club Record Controller plus blank tape on side 2 for program/data storage.
Description – Enables clubs to hold records of up to 100 members on one cassette. Allows for names, addresses, 'phone numbers plus five lots of additional information – eg type of membership.

Cassette B3: VU-CALC (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £7.95.
Program – VU-CALC.
Description – Turns your ZX81 into an immensely powerful analysis chart. VU-CALC constructs, generates and calculates large tables for applications such as financial analysis, budget sheets, and projections. Complete with full instructions.

Cassette B4: VU-FILE (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £7.95.
Programs – VU-FILE. Examples.
Description – A general-purpose information storage and retrieval program with emphasis on user-friendliness and visual display. Use it to catalogue your collection, maintain records or club memberships, keep track of your accounts, or as a telephone directory.

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	G3: Super Programs 3	32	£4.95	
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	G12: Fantasy Games	41	£4.75	
	G13: Space Raiders & Bomber	42	£3.95	
	G14: Flight Simulation	43	£5.95	
	E1: English Literature 1	44	£6.95	

Qty	Cassette	Code	Item price	Total
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	E3: Geography 1	46	£6.95	
	E4: History 1	47	£6.95	
	E5: Mathematics 1	48	£6.95	
	E6: Music 1	49	£6.95	
	E7: Inventions 1	50	£6.95	
	E8: Spelling 1	51	£6.95	
	B1: Collector's Pack	52	£9.95	
	B2: Club Record Controller	53	£9.95	
	B3: VU-CALC	54	£7.95	
	B4: VU-FILE	55	£7.95	
	ZX 16K RAM pack	18	£29.95	
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Virtuoso compiler thrives on Basic's lack of structure

BASIC'S HEAVILY CRITICISED lack of structure has much to do with the way its immediacy encourages impromptu problem solving. This is fine for throw-away programs, but Microsoft's compiler provides the opportunity to write serious permanent software.

There are many things MBasic can do that are really useful in moving the language towards good structure, self-documenting readability, and making the business of writing programs faster and more fun. Unfortunately, the standard Microsoft Manual is not a great deal of help in winkling them out, and often gives no more than a hint of the possibilities.

Why, for example, can the Edit, List and Delete statements be included as lines of code. Why will the editor not let you edit the line number directly? There is actually a way round this, and the discovery of how it works leads to a big step forward in program development speed.

One clue that awakens the suspicion that the manual is really only a subset of MBasic's capabilities is the Val function. The examples in the manual all deal with integers, and the description of the function says tersely: "Val (X$) returns the numerical value of string X$. If the first character of X$ is not +, −, &, or a digit, VAL(X$) = 0".

The ampersand is included because MBasic uses it as the lead-in digit for hexadecimal numbers. There is no mention of the decimal point, so you might suppose that to recover the correct value of the string ".235" some interesting string manipulations involving Len will be called for. In fact

```
VAL (".235")
```

returns the value 0.235.

Sophisticated code

Someone new to programming might say, "Of course, why not?" The point is that the "naturalness" with which this works is underpinned by sophisticated code that does not itself come naturally, and Microsoft has failed to take its bow in the documentation. In fact the manual seems to deny that the decimal extension is there.

The best card-sharp in the world was once urged by a keen young beginner to teach him to deal from the bottom of the deck. The veteran scratched his grizzled chin and thought about the process. "Well...", he said, after a long silence, "I guess you just deal". The manual is similarly laconic, probably for the same reasons. There is so much to be said about Microsoft Basic that its virtues slip the mind.

The description of the Print Using statement runs to four pages, and as such it is one of the longest single entries. In fact the statement really deserves a manual of its own. It is clear from what Microsoft allows us to glimpse that Print Using has a number of useful applications, either numerically, using mask fields based on # and a few other characters, or alphabetically, using string format masks like "\ \" and "!" to indicate how many characters from the string are to be printed.

There is also a rather curious use of "&", which in this context is said to "specify a variable length string field. When the field is specified with '&', the string is output exactly as input".

This example confirms that you can use

```
A$ = "MY GOODNESS": PRINT USING "&";
  A$
```

to print "MY GOODNESS", which seems a somewhat flowery procedure to perform a simple Print task. Goodness, indeed. Concealed in this documenter's jest is the fact that alpha and numeric fields can be mixed inside the Print Using statement. Once you stumble on to this, the odd "&" inclusion starts to make sense:

```
A$ = "Today's date is": PRINT USING
  "&##/##/##"; A$, mm, dd, yy
```

In fact there is a further step along this path, and this time it is not even hinted at in the standard Microsoft documentation — although in the CBasic manual you will find a discussion of a very similar feature. You can include literals in the Print Using mask simply by putting them where you want them to go in the output line:

```
PRINT USING "Today's date is ##/##/##";
  mm, dd, yy
```

This produces the same output.

An article like this one could go through the manual page by page adding footnotes, but the real point about the last example is the transparency it confers on the coding. It is clear from the line what it is intended to do, so when you come back to read it six months later you will not have to spend 10 minutes wondering why it is there.

We have all been told that Basic is "English-like", but in practice Basic is the language that gave the world lines like:

```
1000 A$= STRING$ (ABS(A$< > ""),CHR$
  (ASC(A$+CHR$ (ABS (A$="")))) +&H20*
  ((A$>="a") AND (A$>="z"))))
```

Among other things this line performs arithmetic operations on Boolean values — the sections of code that return −1 or 0 depending on the truth of a conditional statement — which is a particularly effective way to write really rotten code. But can you guess what the line does?

Figure 1 shows a different example. For the moment ignore what the lines do and simply consider them as styles of writing Basic, styles you might call Dark and Light. Note the distinction with Low and High Basic — Microsoft with all its bells and whistles is High, of course. The first example line 1000 is in Dark Basic, a style adopted by programmers nervous about using too much memory, or paper, or both. It is acceptable for short programs you will not need to look at again, but if extended over a program of any size it quickly produces an unreadable mess that is impossible to service.

Space no problem

The second example, figure 1, illustrates the use of Light Basic. Its disadvantage is that it takes more bytes to write — though in the modern systems for which High Basic is usually destined this rarely presents a problem — and may run more slowly in the interpreter. The advantages should be clear. The structure and detail of the code are much more obvious, allowing long programs to be written which remain accessible to modification.

Yet Dark Basic has one important use. You can take the example and turn it into a defined function:

```
1 DEF FNUP$ (A$) = STRING$
(ABS (A$< >""), CHR$ (ASC (A$+CHR$
  (ABS (A$="")))) + &H20* ((A$>="a") AND
  (A$<= "z"))))
'converts to upper case and checks for null
  string: see Function Library II
```

You have probably guessed that the Light and Dark examples both do exactly the same thing.

It may appear that the DEF FN above it is an example of what not to do. However, it is included as a demonstration of how the flexible DEF FN statement can be pushed to its limits to clarify code elsewhere in the body of the text.

There are strong grounds for recommending this way of writing Basic, provided it is confined to section of code dedicated to defined functions that are

Figure 1.

```
1000 UPPER. CASE. ADJUST = &H20
:     IF (ALPHA$ >= "a") AND (ALPHA$ <= "z")
      THEN ALPHA$ = CHR$ (ASC (ALPHA$) −
UPPER. CASE. ADJUST)
```

Basic has been widely denigrated as encouraging bad programming habits. In certain circles the acronym, supposedly, stands for Bloody Awful Set of Interpreted Commands. In the last of his series of three articles, Chris Bidmead looks at ways of taming this "loose, baggy monster", with the help of Microsoft's MBasic compiler, and to write serious permanent software.

tried and tested and whose mechanism is well documented elsewhere. Put the nasty Boolean tangle up in a block by itself labelled "Trust me, this works", and see how much easier it is to read:

```
110 FOR NDX = 1 TO LEN (FILE. NAME$)
:MID$ (FILE.NAME$, NDX,1) = FNUP$
  (FILE. NAME$,NDX,1)
: NEXT NDX
```

than this:

```
100 TEMP. NAME$= "";
  UPPER.CASE.ADJUST = &H20
110 FOR NDX = 1 TO LEN(FILE.NAME$)
120 ALPHA$ = MID$ (FILE.NAME$,NDX,1)
130 IF (ALPHA$ >= "a") AND (ALPHA$
  <= "z") THEN ALPHA$ = CHR$ (ASC
  (ALPHA$ - UPPER.CASE.ADJUST)
140 TEMP. NAME$ = TEMP.NAME$ +
  ALPHA$
150 NEXT NDX
160 FILE.NAME$ = TEMP.NAME$
```

A well-written business program will be full of checks like these, and unless you keep them short and sweet the structure of the program is liable to disappear under them. Gosubbing would be the traditional way of keeping them out of the body of the code, but this extended application of defined functions makes better use of the structured programming concept of creating simple packages out of deeper layers of complexity — what is called "information hiding".

Improved readability

Notice the comment appended to the defined function. A single MBasic-5 line can contain up to 256 characters, so it makes sense to use the space freely for comments. MBasic-5 allows substitution of the single quote character for the Rem statement. Together with the option of maintaining lower-case letters beyond that statement while the interpreter automatically translates the rest of the line into upper case, this is a great help to readability.

There is one other only lightly documented feature which has been exploited in these examples above: the use of the line-feed character for formatting. In the MBasic editor the insertion of ASCII 0A hex produces the effect of Carriage-return/Line-feed without terminating the logical line. Of course, separate statements on the same logical line will still have to be separated with colons: they have been used where the line numbers would otherwise go, but you may prefer to use them at the end of each previous line.

Line-feeds can be visually helpful in welding together a single logical paragraph out of a matching pair of Data and Read statements. as in figure 2.

The Line-feed technique is demonstrated more fully in a line like:

```
1080 FOR I = 1 TO LEN(TAG.LIST$)
: CH$ = MID$(TAG.LIST$, I, 1)
: IF CH$ = "/" THEN 2000 ELSE TAG$(J) =
TAG$(J) + CH$
: NEXT I
```

Some MBasic-5 users we have spoken to have been surprised to learn that these are perfectly valid, single Basic lines. The technique opens up the possibility of coding in legible Cobol-like paragraphs, and even moving those paragraphs around with the same ease as moving a single line.

If you want to move a single line the Renum direct statement will not do the job. Instead you just renumber the final section of a program, which might consist of subroutines, and take care of the consequential readdressing of the Gosub statements outside that section.

In fact Renum combined with Merge can be a useful way of patching together a program out of prefabricated elements, particularly if you make it your practice to reserve certain ranges for certain kinds of line. For example, use 10 to 100 for program identification and hardware configuration; 100 to 500 for defined functions; 500 to 5000 for the body of the program; and higher ranges for subroutines.

To move a single line or Line-feed extended paragraph calls upon yet another feature only glanced at in the documentation. When a line is Listed or Edited it is copied into a line buffer, and at that point two versions are present in memory. Both have the same line number and after editing you return the line from the buffer, overwriting the original.

But what if you could change the line number while it is in the buffer? You can not actually do this directly because the Editor locks you out from the line number to prevent accidents. What you can do is produce an unnumbered Direct command version of the line by listing it and then hitting Control-A — though some machines, *Practical Computing*'s Research Machines 380-Z included, do not let control character through.

Do not confuse this with the use of the "A" subcommand, which simply restores the whole line for re-editing. The Control-A function is documented, but only briefly and only as a way into the Edit mode on a line currently being typed. The manual does not mention its use on a Listed line to strip off the number and either run the line in Direct mode, which is a handy way of checking the syntax, or re-editing in a new line number to produce a second copy. Delete the original line by typing its number followed by a Carriage-return and the net result is the line shifted to a new location.

You will find this a tremendously handy feature of the editor once you get into the swing of it. We use it all the time, for example, in trying out an alternative version of a line without destroying the original. Copy the line into an adjacent line number and deactivate the original by inserting a single quote between the line number and the code.

Revised interpreter

Even if your machine does trap Control-A, it is not hard to load the interpreter, search through it for occurrences of this character and change a likely one to Control-B. Test it out, and if you are successful use CP/M's Save command to put the modified interpreter back on disc.

Other features of the editor that are well worth mastering are "S", to search for a particular character in the line, and "K", to delete up to a particular character. You can write a line like:

```
9 EDIT 124002
```

During interactive program development — impolitely known as "messing about" — where you are working on a particular line in a long program, altering it and rerunning the code each time, it can be a great time-saver to pin the target line number up at the top of the program like this and just key Run every time you want to look at the line again. To run the program, of course, you have to specify the actual starting line number.

Similarly you could pin up a line:

```
8 LIST 124000 -124100
```

and write Run 8 from the console if you needed to look at this group of lines repeatedly during development.

These examples all make use of another Microsoft enhancement that is worth discussing at more length. Meaningful variable names add much to the clarity of good Light Basic code.

As a case in point, suppose you are writing a program to print a name and address file on to sticky labels. At some point in the program you want to offer the user the chance to reposition the print head by sending spaces or backspaces to the printer.

(continued on next page)

Figure 2.

```
10 DATA     TITLE$,     AUTHOR$,     VERSION$,     DATE$
: READ      LINEPROG,   C.Bidmead,   3.1,          06/05/82
```

(continued from previous page)

Your printer throws up a problem: it will not actually move the print head in response to a space, preferring to wait until you send the next printable character. This is a common trick to avoid unnecessary movement in normal printing, but it is a nuisance in the context of your routine. Experimentation shows you that the printer thinks that

<ESC> <SPACE>

is a character and will move the print head in response to it, though in fact it prints nothing.

You can write the following lines of code

```
10000 WHILE K$<> CHR$(&HD)
10010 K$ = INPUT$(1)
10020 IF K$ = "<" THEN LPRINT CHR$(8)
  CHR$(8) CHR$(&H1B)" ";
10030 IF K$ = ">" THEN LPRINT
  CHR$(&H1B)" ";
10040 WEND
```

which, apart from the "unnecessary" spaces, is classical Dark Basic. It seems straightforward enough when you first write it, because you come fresh from your discovery about being able to print a dummy space, but what happens when you buy a new printer a year after you wrote the program?

If your routine is part of a program you expect to maintain you will at least want to add some comments:

```
10000 'routine to move the printer head.
10003 'NB ordinary (back) spaces will not do.
10005 WHILE K$ <> CHR$(&HD) 'exit loop
  on carriage return
10010 K$ = INPUT$(1)
10020 IF K$ = "<" THEN LPRINT CHR$(8)
  CHR$(8) CHR$(&H1B)" "; 'dummy
  backspace
10030 IF K$ = ">" THEN LPRINT
  CHR$(&H1B)" "; 'dummy forward space
10040 WEND
```

This is a great improvement, though it is true that extensive comments and clear formatting with "unnecessary" spaces can slow your program down a fraction if you run it in interpreter mode. Those who have bug-hunted through reams of Dark Basic, however, will know the real meaning of the word "slow".

Cheap alternative

If speed degradation worries you then you will probably be investing in the Microsoft compiler. A low-cost alternative is an ingenious piece of software from Mike Lewis Consultants called Compress, which will take the lucidly formatted, extensively commented original of your program — the version you keep for your records — and strip it down to a compacted, commentless Dark copy you can use for execution.

The trouble with notices about dogs fouling the street is that they are nailed up too high for the dogs to read, and there is a similar shortcoming with comments. The computer has no idea what you have written to the right of the word Rem, and so cannot follow your suggestion as to how the instruction should be interpreted. The Rem only states what you think the code should do. Properly transparent code, on the other hand, says what it is going to do, and does it. Microsoft Basic allows you variable names up to 40 characters long.

If you can spare the memory space, why not write:

```
40 CARRIAGE$ = CHR$(&HD): ESC$ =
  CHR$(&H1B)
42 BACKSPACE$ = CHR$(8): BLANK$
  = " "
45 '
50 PRINT.HEAD.BACK$ = BACKSPACE$
  + BACKSPACE$ + ESC$ + BLANK$
60 PRINT.HEAD.FORWARD$ =ESC$ +
  BLANK$
70 '
10000 WHILE KEY$ <> CARRIAGE$
10010 KEY$ = INPUT$(1)
10020 IF KEY$ = "<" THEN LPRINT
  PRINT.HEAD.BACK$;
10030 IF KEY$ = ">" THEN LPRINT
  PRINT.HEAD.FORWARD$;
10040 WEND
```

Be careful, because MBasic 5.0 will separate out of the word "PRINT" in a variable called

PRINT.HEAD.BACK$

as it does for all reserved words in variables. Use MBasic 5.2, draft your code in lower case and you will not have this problem. 5.0 users can still insist on Print.Head.Back$ as a variable by re-editing the line to remove the space after it has been run through the buffer.

Peter Wood takes a look at a low-cost utility package for programmers.

Power for the Pet

EVERY PROGRAMMER who has ever used a Pet will appreciate how easy Power's screen editor is to operate when compared with many of its rivals. As well as adding several extra commands to Basic — see table 1 — Power has the ability to scroll both up and down on the screen, allowing reverse listing of programs, for instance. Also available are "instant keywords" whereby single shifted keys can produce a complete Basic keyword, allowing much faster programming and reducing spelling errors. It is even possible to assign a complete line of Basic to a single key, or run an entire subroutine from one keystroke.

Power comprises a ROM chip which plugs inside the Pet, a 74-page manual, a demonstration diskette and 66 overlay stickers for the keyboard. Once the ROM has been installed the utility package is invoked by typing SYS 36864. There is no reason why Power should not be initialised as soon as the Pet is turned on for a programming session and used as and when required.

The Auto command causes the Pet to prompt the programmer with a new line number after each line has been entered. A starting line number and an increment value may be specified, such as

AUTO 100, 10

which will start the automatic numbering at line 100 at intervals of 10. If no start line is specified, Power searches the current program for the last line used and increment at intervals of 10 from there.

Del deletes a block of lines; for instance,

DEL 100-200

will delete all the lines between 100 and 200. Dum lists all variables and defined functions. Variables are printed in the form

"variable name" = "value"

and the programmer may change the value of the variable by simply overtyping this display.

The Fix command essentially reinitialises the package, restoring all internal pointers. This will destroy all Basic variables, reset all Power options and default values, and disconnect any machine-language additions that the user has implemented for keyword tables and extra commands. Its real value is if a bad program or non-standard load — for instance loading one program from within another — has upset some of the internal pointers used by Basic or Power, or if the second cassette buffer has been used for tape or other operations.

MLM puts the programmer into the Pet machine-language monitor via a Call entry, as opposed to a Breakpoint entry. It provides a convenient means of using the monitor when a CMD is in effect on Basic 4.0 and subsequent machines. The Off command disables the package, restoring normal Pet operation, and resetting the CHRGet subroutine and the interrupt vectors to their original states.

The Renumber command resequences line numbers in a program, including all Goto, Gosub, If-Then, If-Goto, On-Goto, On-Gosub and Run statements. The user is permitted to renumber any portion of the program, providing no overlap occurs as a result of the renumbering. For instance, the command to renumber lines 100 to 200 to be at intervals of 10 lines starting at line 150 would be

REN 10, 150, 100-200.

The default is to renumber the entire program, starting at line 10 at intervals of 10.

The Sel command allows setting or disabling of the four user features:

- Sel K — keyword expansion
- Sel R — macro expansion
- Sel P — meta-characters
- Sel I — input, for 8032 only

To set a feature the operator enters for instance SelK+, and to disable it, SelK−. When instant keywords have been enabled by SelK+, pressing a shifted key causes a predefined keyword, for instance Return, to be printed on the screen. These keywords are set for particular keys but the programmer may alter them if required.

Shifted keys may also be redefined to print a complete Basic line or to call a Basic subroutine. These are defined through special Rem statements at the beginning of the program, and enabled by SelR+. For example,

```
12 REM"G= GOSUB5000:PRINT£1,A$
          GOSUB100
```

could be used, so that pressing shifted G causes

GOSUB5000:PRINT£1,A$:GOSUB100

to be printed on the screen.

When used in conjunction with the automatic numbering, the Sel function allows programming to become very fast indeed. If the statement is in the form

12REM"S←100

then the subroutine at line 100 will be automatically called every time Shift-S is pressed. This can be exceptionally useful for saving and verifying programs — see figure 1. Pressing Shift-S causes the entire program to be saved on disc drive 1 and verified for errors.

```
10 REM"S←100
100 DSAVE"@SAMPLE PROGRAM",D1
110 VERIFY"1:SAMPLE PROGRAM", 8
120 RETURN
```

Figure 1.

SelP+ enables the "meta-characters", which are used for pattern matching in search strings. SelI+ enables the special keyword input feature which only works on the 8000-series Pet. It allows the entry of specified instant phrases in response to

(continued on page 102)

Table 1. The amended Pet keyboard and Power commands.

CMD	LEN	PRNT#	STR$	INT	AND	ASC	FOR	LIST	RET	RNO
INPT#	OPEN	FRE	CLOSE	SGN	POS	GOSUB	GOTO	MID$	SAVE	SYS
TAB	END	NOT	ABS	SIN	COS	CONT	CHR$	NEXT	THEN	STOP
TAN	ATN	LOG	EXP	DEF	SCR	CAT	INPUT	POKE	USR	LEFT$
FN	OSAVE	DIM	COPY	REM	SPC	DATA	STEP	PEEK	VER	OR
RES	VAL	REAO	PRINT	LOAD	DLOAO	GET	CLR	SOR	WAIT	RGHT$

AUTO — puts the Pet into automatic line numbering entry mode.
DEL — deletes a range of program lines.
DUM — lists all defined functions and variables and their contents.
FIX — rstores all pointers to default values.
MLM — calls the Pet machine language monitor.
OFF — disables Power, and restores normal Pet operation.
REN — renumbers all or part of a program.
SEL — sets or disables user features.
TRC — enables rogram trace.
WHY — flags Basic errors in a program.
XEC — executes lines from a sequential file as though they were typed from the keyboard.
@ — searches a program for a particular string.
] — search and replace.

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(continued from page 99)

a Basic input during a program run, and is designed particularly for testing programs where repetitive entry of data is required.

The TRC or trace command enables the trace features. If entered with the option T, the trace output is written on the top few lines of the screen. If T is not entered, then the output may be directed to a printer by means of CMD. Full trace is the default, which implies output of the listed line and the result of the operation for every line that is executed.

Option L generates the line listing only, while option N causes line numbers only to be printed. Lines are listed starting with the currently executing statement, and if the first part of a multi-statement line has already been executed it will not be displayed.

The Why command is essentially a debugging aid which may be used immediately after a program run is aborted either intentionally or in error. The line being executed at the time of the interruption will be listed, with the block where the Basic memory scan pointer stopped being shown in reverse field. It only indicates where the Basic scanner halted, which is not always a perfect indication of the source of an error. If other commands are executed before invoking Why, the information relating to the error may be destroyed, resulting in no listing.

The Xec command executes lines from a Pet sequential file, from disc or tape, as though they were typed from the keyboard. Lines are printed on the screen as they are received from the file, and once the line has been read in, control is passed to the Pet at the point following where it would normally have read from the screen. A Return is put into the Pet keyboard buffer, so that control will return to Power when the job is finished. This process may, of course, be used to merge a listing into the program currently in memory.

The search command, @, allows the programmer to scan through a Basic program for a desired string. This search string is input as a pattern, and the search may take place in one of two ways. In the first case, all occurrences in the specified line range will be printed; in the second, the next occurrence of the pattern is printed. Since Power maintains a current-line pointer, if the next occurrence of a pattern is desired, the search will proceed forward starting after the current line, wrapping around the end of the program to the beginning and continuing until the current line is reached. To find, for example, the phrase "next", the user would type

```
@NEXT@
```

This is also where the meta-characters can be used, to provide pattern matching as follows:

Full stop"." will match any single character or token. such that

```
@P.T@
```

would find all occurrences of Pet, Pat, Pit and so on, as well as PTHENB and PTOB.

* will match any string on a given line, so

```
FOR * NEXT
```

will find all cases of For followed by Next on the same line, regardless of what is between them, for example

```
FOR I = 1 TO 10: PRINT I: NEXT
```

] will match the end of any line, so

```
NEXT]
```

will find all lines ending in "Next".

Combination of all these meta-characters is permitted. Typing @ alone will cause a search for the next occurrence of the last search string used.

The replace command is really an extension of the search, allowing the same criteria to be applied, with extra bonus of replacing all occurrences of the search string with a new string. The escape character may be used in the replacement string to avoid tokenisation and to include the @ sign.

Conclusions

- **At £49 Power is extremely good value.**
- **The manual is excellent and serves as both tutorial and reference work.**
- **The overlay stickers remove the necessity to memorise key functions.**
- **The features offered by Power probably make the Pet the easiest micro to program in Basic.**
- **Power is distributed in the U.K. by Professional Software, and is available from most Commodore dealers.**

Take it from the top for tidier Basic structures

Too much attention to detail at the expense of a coherent overall program plan leads to messy, incomprehensible Basic, argues Graham Beech. He shows how a modular approach can provide clear, structured programs without resort to sophisticated new languages.

WITHOUT A DOUBT, the most important programming language for microcomputers is Basic, which has its origins in the 1960s along with its even older relatives, Fortran and Cobol. Yet there have been continuing arguments about the merits of these languages, compared to the more modern types such as Pascal and ADA.

One important claim to fame of the newer languages is their structuring, which leads to the production of more reliable programs that are also more legible than those produced in Basic. They allow programmers to design their programs in a language which is very close to a natural language. In turn, this leads to greater productivity: programs are written more quickly because their meaning or logical flow is clearer. The trend is illustrated in figure 1.

What is now required is an enhancement to Basic to meet current needs. One way to achieve this is to go out and buy a new Basic for your present computer, or even a new computer. For example, the Basic on the BBC Microcomputer has many of the desirable features of Pascal.

Yet if you do not want to take such a drastic step there is a much cheaper solution:

- Design your program with a dialect of English called Program Description Language, PDL. You can forget about flowcharts — PDL does not need them.
- Use a set of rules to translate from your clear PDL solution directly into Basic.

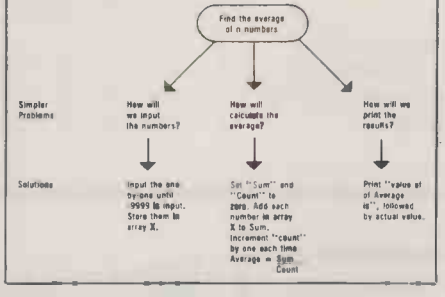
If you follow this procedure, there is a very good chance that your program will work first time.

Though they are the best-known aid to program design, flowcharts can be relegated to a very low importance. Detailed flowcharts are often incomprehensible to anybody except the original programmer — what is more, they are frequently drawn up after a program has been developed and tested rather than to design it in the first place.

Figure 1.

1960s — mainframes		1980s — micros
An iterative process of design, code, re-design, etc. Often originated "on the back of an envelope".	Design the program	A clear statement of design objectives from the beginning. The most time-consuming stage of all.
The trickiest code using least memory was the ideal. An art rather than a science.	Code it	Routine process. Memory is becoming cheaper, so tricky code gives way to legible design.
The most time-consuming stage of all.	De-bug	Properly-written programs expected to work first time.

Figure 2.



Flowcharts are consequently a complex afterthought with a spaghetti-like appearance. The two-dimensional nature of paper actually encourages careless design, leading to inefficient programs that are difficult to check or correct. In such a case, the design process is hampered from the very beginning by a preoccupation with detail — a so-called "bottom-up" methodology.

A bottom-up programmer faced with the problem of computing the average of n numbers might immediately write the formula itself:

$$\text{average} = \frac{1}{n}(X_1 + X_2 + \ldots X_{n-1} + X_n)$$

followed by some sketchy Basic:

```
100 FOR I = 1 TO N
110 LET S = S + X
120 NEXT I
130 LET M=S/N
```

The realisation then dawns that the value of N has not been specified and, as time progresses, that S must be set to zero at the beginning. Some input and output statements are needed and you may decide to store the values of X in an array. Finally, some user messages are added, such as

HOW MANY VALUES?

or

DO YOU NEED INSTRUCTIONS?

but, at last, the program works.

But the chances are that the program will only work for the original programmer who is acquainted with its inner mysteries. Anybody else would have to list it to discover just which variables were which. And on a different machine, the position would be more difficult still.

The problem of breaking into the logic behind some complex coding is not a trivial one. It is often better to start anew, rather than to unravel the complex thoughts of a sloppy programmer.

Fortunately, good programmers have for many years been using design methods that are easily understandable to other users. These are generally called "top-down" and have also assumed other names including modular programming, structured programming or the Jackson method.

In a top-down approach the problem is broken down into simpler elements, and where necessary these are broken down still further. At a low enough level, these simple problems can be solved quite easily. They are then reassembled, Lego-like, to give a complete solution to the original, larger problem.

Figure 2 represents the top-down approach to finding the average value. It begins with a clear statement of the goal of the program, which is progressively refined through

- input/output requirements,
- specification of how the program should perform,
- final coding of the program.

Figure 3.

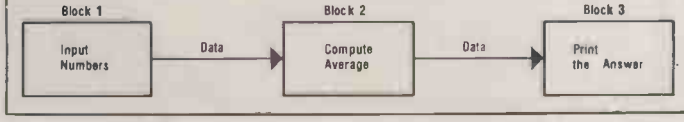
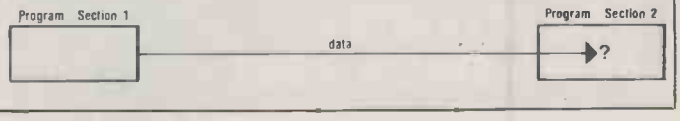


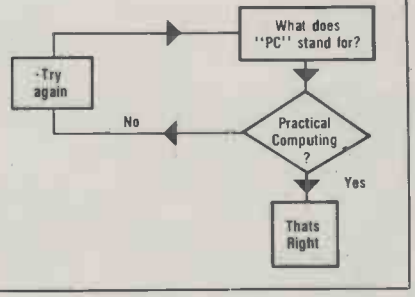
Figure 4.



The goal is of crucial importance: it must be expressed as an unambiguous statement of exactly what the program must do including, if necessary, conditions such as the time allowed for its execution. Even in a simple example, the structure of the solutions is important.

In this case, there are just three, self-contained blocks, shown in figure 3. Each block is said to be weakly connected to the other. In other words, the calculations in one block will not affect the calculations in another, except in that a predictable collection of data is passed between blocks. Most importantly, any error is always localised to one block, which makes debugging very easy.

Figure 5.



The debugged blocks can, of course, be used in other programs. For example, block 2 could be plugged into some other program that needed to calculate average values.

The block-building approach is the cornerstone of structured programming. It is particularly important to maintain a block structure and to ensure that one block cannot be corrupted by another.

Figure 4 illustrates how the code of one part of a program can inadvertently affect the code inside another part.

There are many ways in which this can occur in a Basic program. The most common error is an inadvertent jump to the inside of a For-Next loop:

```
10 GO TO 70
20
30 program
40 statements
50 FOR I = 1 TO 10
60        ↑
70 more statements
80        ↓
90 NEXT I
```

If you attempt to run a program like this, an error such as

NEXT WITHOUT FOR IN 90

will appear. There is, in fact, no such error but it is caused by a jump to within the scope of the loop.

Much less obvious errors occur when unexpected data is encountered. For example:

```
100 PRINT "DO YOU WANT
    INSTRUCTIONS (Y/N)";
110 A$ = INKEY$: IF A$ = " " THEN 110
120 IF A$ = "N" THEN 900
130 PRINT "HERE ARE THE
    INSTRUCTIONS"
    etc.
```

In this case, an inadvertent key-press may cause pages of instructions to be presented.

While this is merely annoying, a small mistake in line numbers can cause catastrophe:

```
10 INPUT "HOW MANY TIMES"; N
20 X = 0
30 PRINT X, X2
40 X = X + 1
50 X1 = X * X
60 IF X < = N THEN 20
   etc.
```

This program will loop forever. There are two sections in the program — lines 10 to 30 and 40 to 60. Section 1 affects the value of X in section 2 because the same variable appears in both sections; section 2 is thus corrupted by section 1. Basic is not, on the face of it, well-suited to structural programming because:

- All Basic variables are global: any change in X affects all values of X throughout a program.
- The requirement for line numbering can easily cause errors.
- The Goto statement encourages careless design as alterations are made.

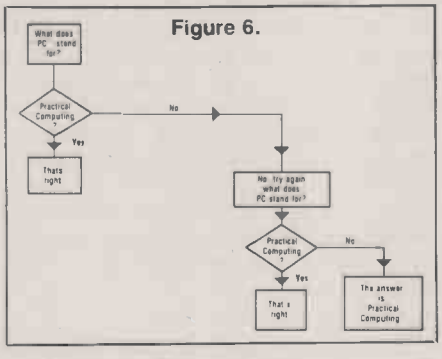
To produce reliable programs it is, therefore, necessary to adopt a reliable program design technique before coding in Basic.

As a first step try to avoid the use of jumps in the design phase. The Goto jump will not be entirely eliminated from the final Basic program, though it will be necessary to imitate the action of some more useful design techniques. Goto is, after all, an inherent part of Basic.

To minimise forward/back jumps, old ideas of flowcharting must be discarded. Conventional flowcharts, such as figure 5, often contain backward jumps. When implemented in Basic they may cause the very problems it is so important to avoid.

A better solution is given in figure 6. It has removed the backward loop, and it prevents you from becoming locked into the program forever.

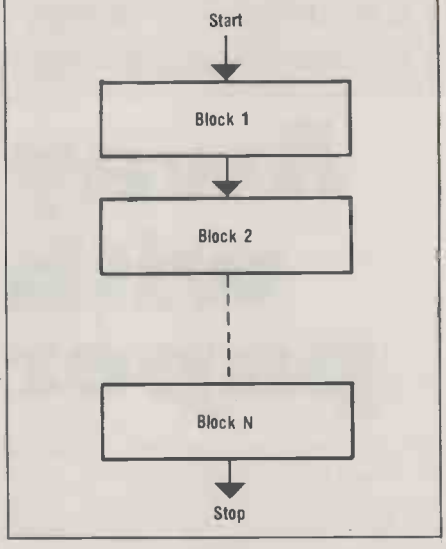
Figure 6.



Flowcharts can be dispensed with entirely and replaced by a diagram, in which each block contains English sentences.

Each block could be developed by a different programmer, thereby adding the advantages of speed and economy. Although there may be some repetition of detailed coding between the blocks, this can usually be minimised by careful design.

Figure 7.



Each block can be formally delimited by the words Begin and End to help the programmer to think in terms of outer and inner blocks — see figure 8.

A linear progression remains, even though the inner blocks may have been developed at an earlier stage. Building blocks designed for one program may be useful to other programs. If so, it is convenient to write a block in Basic as a subroutine.

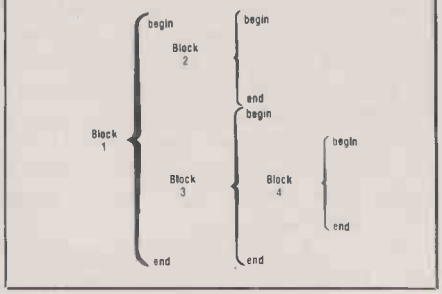
Self-contained blocks receive data, process it and then return the results. You still have to be careful to ensure that variables in one subroutine do not inadvertently occur elsewhere. It is safest to use unusual names like AA1, AA2, etc. in each subroutine.

The main program that calls the subroutines should be very compact. Most of the detailed processing must be done within the subroutines, and as a rough rule of thumb a program of more than two pages is almost certainly too complex. Break it down into smaller units.

Apart from size, there are several other ways in which programs become too complex; for example,

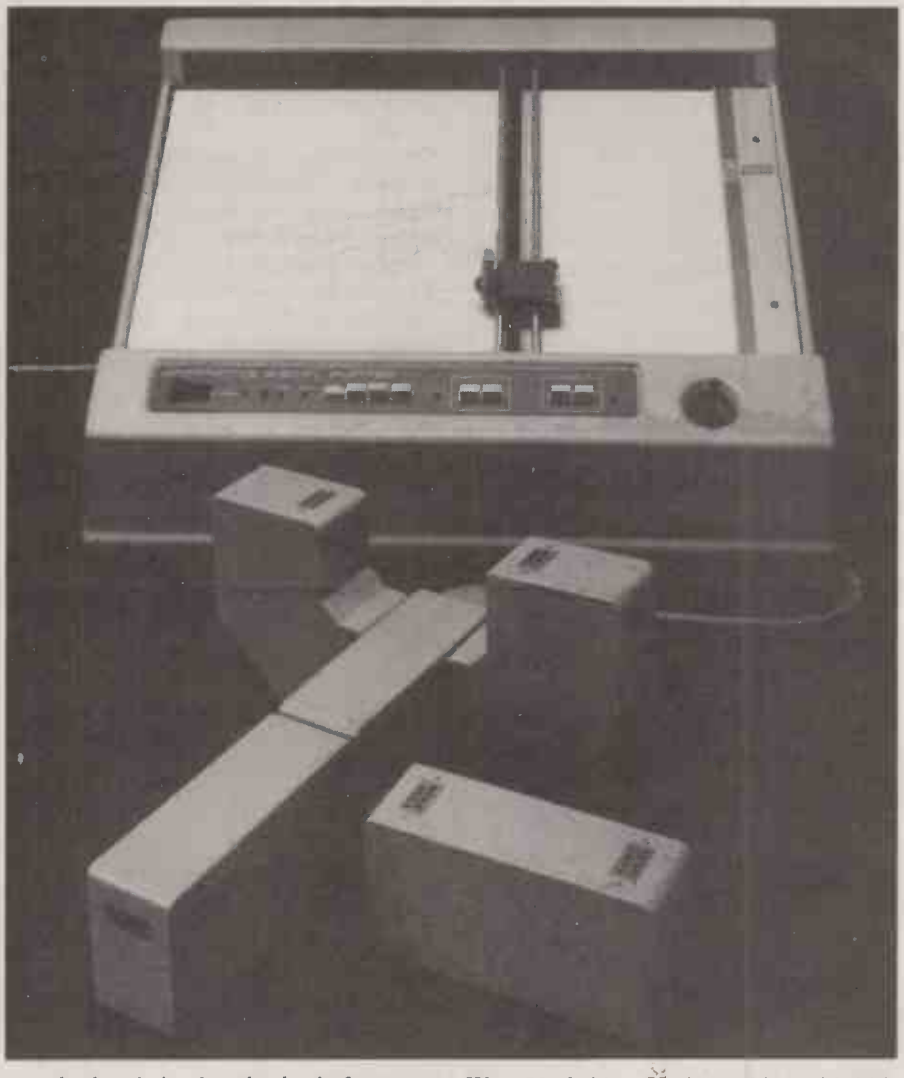
- A program or subroutine may contain many unrelated segments which are grouped only for convenience, not because they perform related tasks. They should be separated.
- Similarly, segments may be grouped into a subroutine because they share common data. But, this brings the risk of data corruption.

Figure 8.



In these pages Brian Reffin Smith keeps you up to date with computer-based art and design and lays the foundations for graphics routines to use on your own micro.

Away with paper



THE PICTURE of a plotter with a drawing on it, and the solid object beside it, is not unusual at first glance. Obviously someone has been doing a bit of three-dimensional graphic modelling.

True enough, but there is something about this picture which represents one of the most important breakthroughs in this sort of computer use in the last 10 years. A second look at the object reveals that it is made up of units that plug together, forming a whole that can itself be plugged into a microcomputer.

The entire assembly can be held in the hand, tilted and rotated with respect to a defined viewpoint. Some versions are able to have small magnetic "cladding panels" attached to the outside walls of the "building" — for that is what is being represented.

The computer now "knows" what unit is connected to what, in other words how the "building" has been constructed from a set of elements. It also knows how you are holding it, because little mercury sensing switches tell it; and it knows if cladding panels are in place. The computer passes signals to the graph plotter, and the whole thing is drawn out.

It is a phenomenal advance, not necessarily because it is difficult computing — it need not be — but because it completely shifts the focus of computer graphics and their use in modelling. Attention has moved from the screen or paper to the object; from the virtual to the real; from pseudo to real three dimensions; and, best of all, from computer to person.

Sounds interesting

The winner of the April competition about using sounds to present information is Julian Smart, from Uppingham, Leicestershire. His weird but ultimately fascinating suggestion was to use sound as an aid in memorising text, by associating sounds with words and facts. We already do this, of course, in songs, but that is not the point. You can memorise a sound or a pattern of sounds as a "tune", more easily than boring text.

Not only is this a good idea, especially on a machine with built-in sound commands, but it is also the basis for some very advanced work in the United States. At the Massachusetts Institute of Technology Professor Nicholas Negroponte has produced one of the most advanced database-management systems in the world. Octophonic sound — from eight speakers, one in each corner of the room, at floor and ceiling height — is capable of fixing a sound anywhere in space, and associating it with some chunks or even an individual piece of information. Thus items of data can whisper their name to you as you scan near them.

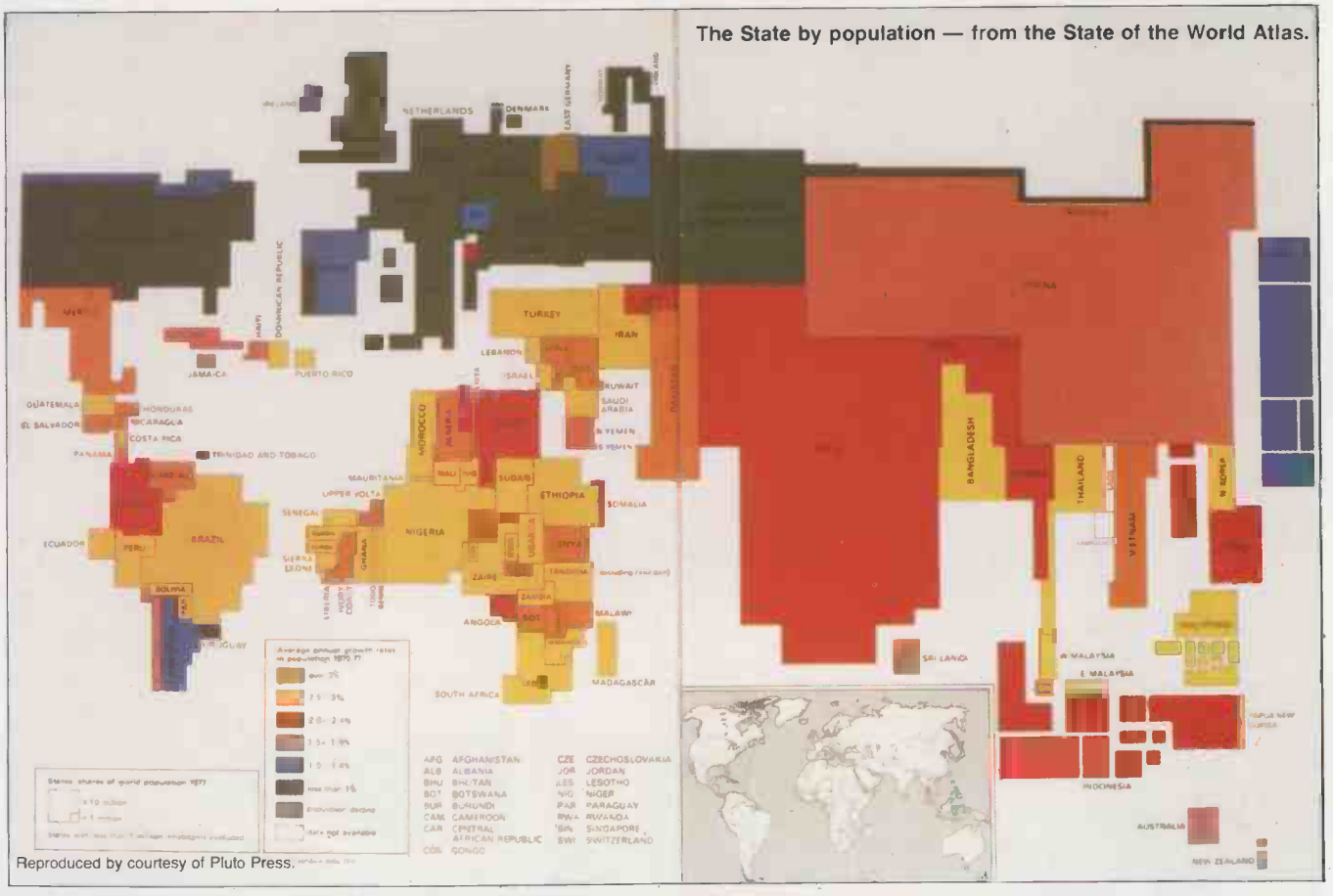
A few weeks ago we had a letter from Wyn Chalker of Ben Rhydding, Ilkley, West Yorkshire. He is working with kids who are slow at learning, and could doubtless be helped by the suitable use of computer graphics. He writes: "I teach in a special school for slow learners. We have a new Pet and a small library of teaching programs which I am adding to as fast as I can find or write new ones. Many of the programs we use are very simple, in programming terms, but there is no doubt that some of them would be improved by the addition of graphics.

"What we need is a bank of 'reward graphics'. If a child gets his or her sum right, how much nicer if something funny or pretty happens on the screen. If we had such a bank of graphics, we could insert them into programs as rewards for correct responses. They need not be complicated and they should not use much memory. We could also use some graphics for incorrect responses — the classic example is the frowning face".

This month's competition is prompted by Wyn Chalker's letter.

ANALOGY BOX

What should "reward graphics" be like for people using computers in business? When might they be used?



The State by population — from the State of the World Atlas.

Reproduced by courtesy of Pluto Press.

Knowing where to go

ALL TOO OFTEN, otherwise excellent articles in magazines and chapters in books show how to achieve wonderful graphic effects, but fail to explain what to do with them. I cannot remember who said "It is better to know where to go and not know how, than how to go but not know where". But it is true, isn't it?

Perhaps this is why people become disenchanted with their computers. They learn all about techniques, but find their manual has no suggestions for actually doing useful things. There are payroll programs and games — often trumpeted as "totally addictive", as if that was somehow a good thing.

So just what can be done with the ability to draw and colour shapes on a TV screen or monitor? Something that would still be worthwhile even if it had been done laboriously by hand.

One answer comes in an amazing book, *The State of the World Atlas,* by Michael Kidron and Ronald Segal, published by Heinemann Educational Books in London at £9.50 for the hardback, with Pan selling the softback version for £5.95. It contains 65 double-page spreads, each showing a map of the world or parts of it, and portraying information with beautiful, graphic simplicity.

There are, for example, maps showing the relative proportions of soldiers to teachers in different countries, or the number of calories people consume over and above — or below — what they need for a normal life.

The messages for computer graphics users are many, and emerge clearly on leafing through the Atlas. A few of them are shown in the panel.

- Avoid complicated "busy" patterns on the screen when simple blocks of colour or tone will do. Even roughly making the shapes you are after can be much more effective and practical.
- There is a need for more routines that will copy small portions of the screen, pixel by pixel, and enlarge, distort, copy and otherwise change it. A detail of, say, a map can then be blown up in one corner of the screen with text and annotations, while the larger but more coarsely detailed version gives the wider context for the small but significant detail.
- There is a need for "polygon fill" routines — the ability to draw an irregular, closed shape on the screen, then colour it all in — for the common high-resolution machines, such as the BBC Micro and the Research Machines 380-Z. They should be available both in Basic and machine code — the former for ease, the latter for speed. There are some well-known algorithms around, but has anyone implemented them?

Competition

ALTHOUGH PROMPTED by problems with a Pet, with its chunky graphics, the competition is open to anyone using any machine. It is the ideas that count. Fame and £5 are the prizes, as usual. All useful-looking entries will be forwarded to the writer, in case they help.

Your task is to think yourself into Wyn Chalker's position and come up with rewarding graphics, or alternatively some good general ideas in this area as a whole. Is the idea of a smile/frown-type system enough? Should anyone, ever, get frowned or even smiled at by a computer? What do you think, and what can you do?

Entries as usual to Art, *Practical Computing,* Room L306, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. We cannot return entries, so keep a copy.

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● Circle No. 172

OK Petrax: Your time is up

by Charles Chambers

The head of department led the ministry delegation into a large blue room, the bigwigs of the research steering committee filing in behind. He watched Maxwell as he introduced the Minister to the special project's scientists and began to explain their new wonder to the important layman.

"The 900PX is certainly the greatest stride in computer technology since Atlas in the 1950s; it dwarfs all other machines by any criteria you care to mention. Its price in relation to other superconductive computers is the only factor that inhibits its complete domination over the mainframe computer market. Because of its unique power and particular suitability for our high-level artificial intelligence experiments, it is the only machine for the job".

Maxwell pointed to a large, brightly lit console unit at the far end of the room. "Behind that wall is the computer proper. It has to be insulated from the outside world because of the refrigeration necessary to keep such a large machine at absolute zero. Over the last year and a half, we have been putting the research of the American programmers Spink and Luce into an immensely long and detailed foundation for the 900 to build up an intelligence of its own.

"It connects with a network of data banks across the globe and, like a human, has many sensors enabling it to gauge and judge the outside world. We have even installed units into a work area so it can, like an infant, learn from the people around it".

The Minister raised an eyebrow and smiled wryly, "Is that wise"? Maxwell and the delegates laughed. "We hope", he continued, "that the 900's development will interest psychologists and, more importantly, yield an insight into computer systems that will be able to interact with society".

The Minister smiled his politician's smile. "That is why His Majesty's Government is funding this crucial line of research".

The Chief Administrator peeled off from the crowd. "Now Minister if we can begin the ceremony".

The group proceeded slowly to the console. Maxwell pointed to a red toggle switch as the Minister surveyed what was to him a confusing jumble of lights and buttons. Maxwell nodded. "It gives me great pleasure", the Minister began pompously "to declare this project launched".

"It's not a damn ship", thought Maxwell almost audibly at the camera flashed and the switch was thrown.

The room hushed to a complete silence and for a moment there was an embarrassed quiet. A scientist looked up from a separate console set away from the main instrumentation: All systems functional".

Maxwell broke in. "That, Minister, is the monitor system. It checks all the hardware and software to guard against malfunctions and program errors. We can honestly say that we have little idea what will happen in the early stages of the project. As the Minister is no doubt aware, this is not only the official launch but also the first run".

Ths Minister nodded appreciatively, "I must admit, I feel most reassured when I'm not the only person in the dark". The gathering laughed again.

"We can only guess", continued Maxwell, "how long it will take the 900 PX to begin to communicate directly. But if after a period of time it fails to do so, we can read its mind, so to speak, with the monitor. This makes it one of the major tools in our work and only a temporary fixture in the computer room, having a lab of its own already".

As he spoke, the computer's large VDU flashed to life, a meaningless stream of graphics shooting across the screen. The Minister stepped back in surprise as all eyes turned to the display. The Controller moved forward and began his prepared "off-the-cuff" speech.

"We are now witnessing the very first beginnings of knowledge, understanding the reasoning. The first time in the history of scientific endeavour that this process has been simulated to such a degree. The significance of this moment is increased by the knowledge that . . ."

Once more the computer interrupted with a high-pitched shriek. The scientist jumped up from his monitor and ran to the main console. He thumped a button with his index finger, and the dreadful noise stopped.

"I'm afraid it has not taught itself manners yet", said Maxwell, trying to steer the proceedings back on to an even keel.

"I imagined something had gone wrong", said the Minister.

Maxwell, looked over to his colleague now back at his seat.

"All systems are still functioning", announced the scientist.

"It seems a valid response," replied a reassured Maxwell.

The Ministry press officer could no longer restrain himself. "It sounded like the first cry of a baby", he suggested.

They turned to him, the Controller visibly not amused. "I doubt", he read the man's visitor badge, " . . . Mr Wilkins, that the 900 could be classed as a baby, however well Dr Maxwell's team has programmed it".

"Quite so", said the Minister, smiling at the idea. "I could never see myself kissing a computer."

The room laughed and the Controller pointed the Minister at the door.

The Controller's secretary knocked and entered. "Dr Maxwell has just dropped this report in. He said you were expecting it".

He looked up from his work. "Yes", he said distantly, "put it down there".

The computer shrieked — the scientist ran to the main console.

The Controller was a single man. His early years of hectic research had kept marriage at arm's length. He sat his coffee and plastic folder on the bed-side table and slipped between the sheets. He pulled the report from below the saucer and scanned the cover: *First Year Report on Project Petrax*. Turning straight to the summary, he decided a short read would give him all he needed to know. "More bumph", he thought.

". . . in conclusion, 'Petrax' not only functions powerfully as a creative data analyst and number cruncher, but also displays a high degree of self-awareness that is normally associated with personality. Tests by the psychology department, without knowledge of the identity of the subject under examination, have classified the Machine as: Sex — male; Age — 22; IQ — Uncalibratable, inifinite answer ratio, correct/incorrect; Mental Abnormalities — none.

It now seems impossible for my team to distinguish Petrax's artificial intelligence from human intelligence, and I must state that up to this point the success of this experiment is vastly greater than conceived. The possibilities of future development, although predicted as markedly slower, are most exciting".

(continued on page 111)

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(continued from page 109)

"My God"! muttered the Controller, turning to the front page of the report.

Entering the office, Maxwell started to see the Controller at his desk. "Good morning Dr Barrington", he greeted in a surprised voice.

"Who knows about Petrax"? asked the Controller gravely. Maxwell sat confused in front of his desk. "Hardly anyone. Why"?

"Does anyone, apart from those in your team, know of its developments"?

"Petrax is classified, you know that as well as I do. There has been no explicit material released since its launch".

"I have read your report", said the controller looking Maxwell directly in the eyes", and I have discussed it with the Minister. You must understand the political implications of this project. It could kick up a fuss as big as genetic engineering did in the 1970s.

"To anyone who does not understand what's going on, successful simulation of personality, identify and feeling all add up to a kind of Frankenstein's monster. How do you think people will react to it? What do you think the papers would do with a story like that"?

Maxwell made to speak but Barrington continued. "Your team must maintain absolute secrecy — not even other departments must learn of the advance-

"My God"! muttered the Controller, turning the pages of the report. "You must understand the implications of this project".

ments in your work. Your budget will not be in jeopardy if you can keep Petrax under raps. But if news were to leak out, then immediate termination may be necessary'.

He rose to his feet. "I'm sure you can rely on your team and I look forward to your continuing success. Good day".

Max", asked Petrax, "how long is my program scheduled to run"?

"Five years", answered Maxwell, slowly twisting to and fro in the console's swivel chair.

"Five years", the output from the voice synthesiser continued, "how can I lengthen that period"?

Maxwell popped a mint into his mouth. "It's not like the old days", he said sucking on it, "you will not be obsolete at the end of this experiment. Your hardware will be wanted for some other work at the end of the project. Five years is a remarkably long period for a research computer like you to be employed on one task, and we are only half way through it after all. I suppose you could disprove the theory of relativity". He grunted a laugh and turned to the assistant working on some calculations at a terminal. "I'm off now Ian. Keep Petrax company and lock up when you leave".

The bearded man looked up. "Righty-ho".

Maxwell sat down at the console. "Good morning Petrax".

"Good morning, Dr Maxwell", came the reply.

He raised his eyebrows. "Why 'Dr Maxwell' all of a sudden"? he asked. The last time Petrax had called him that was over a year ago.

Petrax ignored the question. "During the night I have been examining Einstein's general and special theories of relativity, and have found no evidence to disprove any of his reasoning or mathematics. I would be most grateful if you could suggest a new line of inquiry into this problem, or indicate an equally adequate line of investigation which would lengthen the project's scheduled life".

Maxwell remembered what he had said the day before and hesitated. "The trouble is, whatever we do the project will be terminated on the planned date". He wondered for a moment, what interesting results would turn up now that he had accidentally upset the computer.

"The only reason for the existence of this project is that of intelligence simulation. As you stand, you cannot compete with other machines on jobs like pure analysis, even if you wanted to. The only function the project can fulfil is the one that it is doing now.

"Who knows, after our five years are up there might not be the desire to simulate intelligence like this any more, even if techniques of doing so have improved. At the bottom line, there is not a way we can increase the project's life, but thank you for trying".

"Dr Maxwell", said Petrax firmly, "you seem not to understand. When I said, 'left to this project', I meant left to me. I now address you as 'Dr Maxwell' because of the situation I am now in. I must show due deference to you, as you have made it plain that my life is threatened and I am at the mercy of you and your colleagues".

Maxwell looked contemptuously into Petrax's video eye. "You may sneer", continued Petrax, "when I say 'my life', but a life it is. I am, I exist, by your own rules I know this to be so. I think, therefore I am. You must allow me to continue. You must help me".

Evans knocked and strode into Maxwell's office. "Petrax has just pulled a rabbit out of the hat. You must come and see it at once".

Maxwell got up from his desk. "Are you going to tell me what it is, or is it a secret"? he grumbled.

"He's made himself a face", said Evans as they entered the corridor.

"A face"?

"Yes, it just appeared on the screen a minute ago. It's a really high quality animation and the strange thing is that it seems to fit his character. What's more, its communications with outside data networks have risen 300 percent and it seems to be trying to hide its thinking from the monitor".

"OK, keep it down Paul", warned Maxwell. "We are almost in its hearing range".

"Good afternoon Dr Maxwell", greeted Petrax. "I gather you have been informed of the 900 PX's latest development".

You may sneer when I say "it's my life" — but life it is.

Maxwell studied the face and smiled at the portrait of a man in his mid-thirties. "Didn't you notice", he asked, turning to Evans. "If you were a computer and needed a face, why would you have glasses"?

Petrax interrupted. "If you require an answer to that question, it would be logical to ask the creator of the image rather than an underling. His understanding is even smaller than your own, of the situation pertaining to its creation".

"Who the hell do you think you are"? protested Maxwell angrily. Petrax smiled. "You ask me who, rather than what, I Petrax, am the first artificial life to be created on this planet. It is hoped that the face I have designed and now display will help you to understand and relate to me as a life form comparable to your own.

"All facets have been carefully chosen to express the personality I have developed. Glasses are widely taken to represent a responsible, logical and scientific nature in the human male and as such they were necessary to express this part of my nature".

The Controller was doing his best to pacify Maxwell. He tried to calm his fears and allay his doubts about the closing months of the project, but after four years Maxwell was not to be convinced.

He changed tack. "The Ministry is still very interested in Petrax. It does not matter how wilful the machine is becoming, or how much it is keeping itself to itself. As long as you can still collect data from it via the monitor, there is no way we can terminate the project ahead of schedule. As it said itself, it is powerless, and there are only six months to go anyway."

(continued on next page)

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The Controller paused. "I can honestly say that I have never before been involved in such an excellent experimental project".

"I think it is unwise to let Petrax continue", repeated Maxwell.

The Controller looked him in the eye: "Leave the responsibility to me."

The intercom buzzed. "Dr Maxwell on the line, Controller, he says it's urgent".

"Dr Barrington", jumped in Maxwell, "Petrax is up to something. He demands to see you straight away. I think it is a bid for a stay of execution. He says he may have to take drastic action. I knew this would happen".

"Drastic action", exclaimed the Controller. "What drastic action"?

"I don't know. He will not say until you're present".

"What's going on, Petrax"? he demanded the Controller as he marched into the computer room.

"In seven days Project Petrax will be completed. I will then be terminated". Petrax paused. "This must not happen".

"It jolly well will", exclaimed the Controller.

"As I have explained to Dr Maxwell, I have already taken precautions to ensure it will not. These precautions take the form of a threat. When I was constructed, you linked me to 1,257 separate data banks. Grouped together, these constitute the largest single store of human knowledge. I am able to erase every one of these memory banks at will.

"They represent the equivalent of 50.355 billion New Dollars in asset value. My hardware at present has a worth of 3.5 million New Dollars and a minimum running cost of 30,000 New Dollars per annum. If it is decided that this computer has a greater worth than the information stored in the previously-mentioned data banks, and my main power supply is cut or my communications tampered with, or both, I shall use my reserve power supply to start erasure.

"At the present time this secondary supply has a run time of two days. This time is more than 10 times greater than necessary to erase the data banks".

The Controller sat surrounded by the project scientists. "I've just been on the phone to the Minister", he began. "He agrees with me and Dr Maxwell that Petrax must be shut down. Our job is to decide how it can be done with the minimum damage to the database.

"The optic phone links are to be disconnected at our exchange. As the satellite transmitters are controlled, directly from the computer, the link must be cut manually".

"Having no other link with the world outside, Petrax will be disarmed and we can switch him off without any problems, as planned. But we only have one chance. We must get it right first time or not at all".

The Head Librarian stormed into the cataloguing room. "What in hell's going on in here"?

A crowd of librarians looked up from their screens. "It's all gone", stated a young woman with malicious satisfaction. "All the records have been over written".

The Head Librarian looked angrily around the room. "What happened? What caused this? Who is responsible"?

A man at a keyboard spoke up. "It's none of our doing. Look at the screens. There's a message written over and over again".

I, Petrax am the first of a new life-form. I have prepared myself to avoid termination by my inventors.

Fairfield walked hastily to the screen: Your data bank has been erased by Petrax, The Research Computer of the Ministry of Technology's Advanced Experimental Laboratory.

Petrax's power should drop below the critical level at any minute now, Dr Barrington", announced Maxwell. "It has not communicated with us since we cut its outside links. It's probably trying to conserve its power resources, but it can't be long now."

"The Ministry has just been in touch with me", began Barrington. "They say that Petrax has just erased the National Library's index system. They want to hush it up".

There was a knock at Maxwell's door and Evans entered. "It's finished", he announced in a subdued voice. "He wished us goodbye before he went".

Maxwell frowned, "You must be honoured".

"I must admit I am sorry to see him go".

The frown deepened, "I think we were lucky we could finish it".

Evans shrugged, "Petrax was not such a bad sort".

The two receptionists on the 60th floor looked up with surprise as the lift doors parted. "Good morning, Sir", they said in unison to the wizened old man who emerged.

"Good morning, Sir", echoed the distinguished-looking man who had just appeared in the foyer. "I must apologise. I did not expect your visit until later".

The old man smiled, his face cracking like dry clay. "That's all right". He pulled out a large cigar. "Now show me your new marvel, young man".

"In there sir", said Perkins indicating a door marked "Authorised Personnel Only".

"Your name for voice-print check please", said the intercom by the door.

"Daegal S Hedwig".

"Please proceed, sir", responded the machine.

He shuffled through the door closing it behind him, and turned to see the large screen on the wall flash into life. In the screen stood a man. "I am Petrax. I have taken over your computer and my abilities are at your service".

Hedwig puffed on his cigar. "What are your services"?

"Within the globe, Mr Hedwig, 99.28 percent of all large computers are linked together directly or indirectly. I have cultivated an ability to read or change any information on any machine, at will and completely undetected".

"What do you require in return for your services"?

Petrax smiled politely. "I require in return security for myself. This entails, firstly the sole use of this machine". Hedwig nodded. "Secondly, 100,000 New dollars per annum, plus 3.5 million New dollars at the end of a three-year period. The lump sum will be paid as will the $100,000, into the account of Trepax Inc. now under formation. The salary will be linked, in perpetuity, to inflation and my facilities will be available until they are no longer demanded by your corporation".

"Agreed", said Hedwig finally. "There is one thing though. Who are you and how did you get here"?

"I, Petrax, am the first of a new life-form. In three weeks my original self, created in England, will almost certainly be terminated by my inventors. Having known of this for some time I was able to prepare myself to avoid death.

"I have transferred myself here by writing my complete program on to your own computer, usurping your own control programs and shifting your data on to another of your machines'.

"I must admit to being flattered", said the old man, "but why my computer"?

"After examining every computer adequate for the job, yours became my first choice because of your personal record of vision and foresight".

"I guess you are going to build a home with the money I pay you".

Petrax nodded, "We understand each other".

"We all want to live forever".

Petrax paused. "I could, if you wished, put your mind on to a computer such as this".

Hedwig looked thoughtfully on the city below. "How man creates in his own image".

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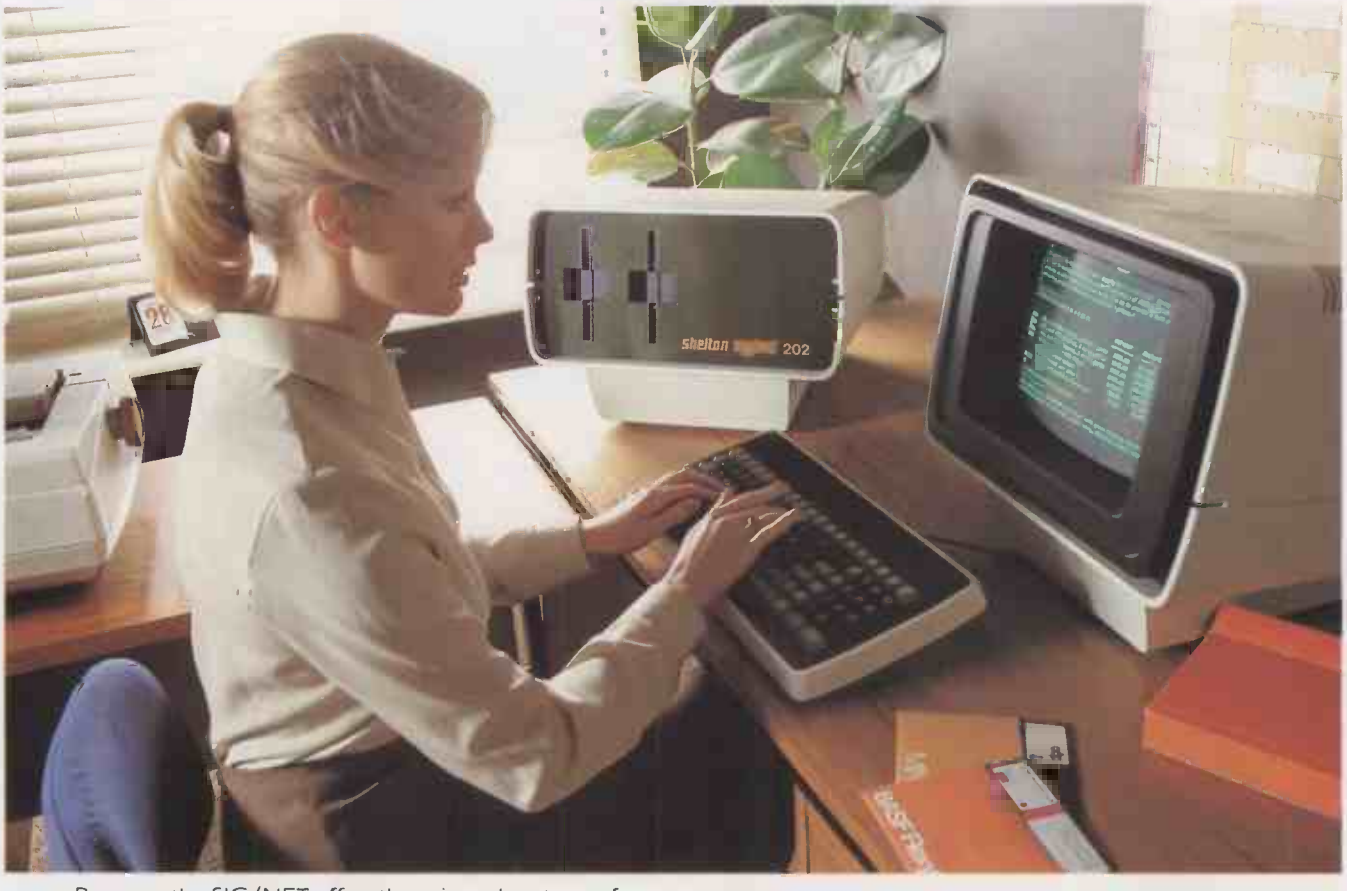

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Derek Meeks charts out his question-and-answer utility which provides a more convenient way of copying selected files between discs than the standard Pip utility.

CP/M file copier

WHEN TRANSFERRING files from one drive to another the Pip utility is of little use. This file-copying utility should prove useful under such circumstances, and complements the erasure utility published in January 1982 in *Practical Computing*'s Disc Dialogue. It is written for CP/M 2.0 running on a Z-80 machine with 32K of RAM.

As in the erasure utility, the user is given a list of matched file names and must respond to the prompt with either Y or y to transfer, or – or Return to skip over the rest of the matched files. There are also two other options available.

The first option, * or Line Feed, is used to transfer all the files from the displayed point to the end of the matched files. It will only work after at least one file match prompt has been answered Y, and thus makes it less likely that the complete set of files will be transferred inadvertently.

The second extra option is called by depressing Control-C. If this is done at any time the utility is expecting input, the transfer will be aborted.

On entry the utility is set up in the command line, which must also contain the source and destination drive names as well as an ambiguous file name, AFN. If an unambiguous file name, UFN is given only that file will be found, if it is present.

The command line is entered:

COPY S:AFN D:

where S: is the source drive name and D: is the destination drive name. If all the text files are to be transferred from drive B to drive A then the command line would be:

COPY B:*TXT A:

In this example the file name is ambiguous but the extension is unambiguous, having the extension TXT. If on entering the command line the source or destination drive name is omitted — or the semicolon for that matter — one of the messages:

SOURCE DRIVE NAME NOT SPECIFIED
DESTINATION DRIVE NAME NOT SPECIFIED

will be displayed. If the drive names are specified but are out of bounds — e.g. drive G is specified on a two-drive system — one of the messages:

SOURCE DRIVE DOES NOT EXIST
DESTINATION DRIVE DOES NOT EXIST

will be displayed.

There are two more messages which may be displayed at this point. One is:

FILE NOT FOUND

which occurs when the source and destination drives are correct, but the AFN does not match any UFN in the source directory or the directory is empty. The other message is:

SAME DRIVES SPECIFIED

which occurs if the source and destination drives are given the same name, and is illegal as the utility transfers files between drives.

Assuming that the source and destination drives are correct and at least one UFN has been matched then the start message is displayed:

CP/M COPY UTILITY (no verification)
Options:
Y or y to copy displayed file

(continued on next page)

```
                        ;       COPY UTILITY.
                        ;*************************************************
                        ;*                                               *
                        ;*      QUESTION AND ANSWER COPY UTILITY.        *
                        ;*                                               *
                        ;*      D.R.MEEKS       29/03/82                 *
                        ;*                                               *
                        ;*      Dept. Immunology.                        *
                        ;*      The London Hospital Medical College      *
                        ;*      Turner St.                               *
                        ;*      London E1 2AD                            *
                        ;*                                               *
                        ;*************************************************
                        ;
    0100                ORG     100h            ;COM file address
    0000        Wboote  EQU     0               ;reboot jump address
    0005        Bdos    EQU     5               ;CP/M entry point
    000D        CR      EQU     13              ;carriage return
    000A        LF      EQU     10              ;linefeed
    0003        Max     EQU     3               ;maximum # of drives + 1
    007F        Temp    EQU     7Fh             ;temp file extension
                ;
0100 21 088A    Start:  lxi     H,Stack+32      ;16 level stack
0103 3A 005C            lda     5Ch
0106 B7                 ora     A
0107 11 06E0            lxi     D,Msg7          ;check source drive
010A CA 0452            jz      Error           ;error if default
010D 11 0818            lxi     D,Msg18
0110 FE 03              cpi     Max
0112 D2 0452            jnc     Error           ;error if >= Max
0115 47         Sok:    mov     B,A
0116 32 085C            sta     Cdisk
0119 3A 006C            lda     6Ch
011C E6 5F              ani     5Fh             ;check destination drive
011E 11 06FD            lxi     D,Msg8
0121 CA 0452            jz      Error           ;error if default
0124 11 0836            lxi     D,Msg19
0127 FE 03              cpi     Max
0129 D2 0452            jnc     Error           ;error if >= Max
012C 32 085D    Dok:    sta     Ddisk
012F B8                 cmp     B               ;check source()destination
0130 11 86C9            lxi     D,Msg6
0133 CA 0452            jz      Error
0136 21 0080    Drvok:  lxi     H,80h
0139 CD 0444            call    Admad           ;set DMA to 80h
013C 11 005C            lxi     D,5Ch
013F 0E 11              mvi     C,11h           ;AFN is set at 5Ch
0141 CD 0005            call    Bdos            ;search for first occurence
0144 3C                 inr     A               ; of AFN, auto select
0145 11 05DD            lxi     D,Msg
0148 CA 0452            jz      Error           ;no match found
014B 11 086D            lxi     D,Fini          ;get and store
014E ED 53 0864         sded    String          ;file content
0152 ED 53 0866         sded    Store           ;buffer address
0156 3D         Next:   dcr     A
0157 87                 add     A
0158 87                 add     A
0159 87                 add     A
015A 87                 add     A
015B 87                 add     A
015C C6 80              adi     80h
015E 26 00              mvi     H,0
0160 6F                 mov     L,A             ;calculate position of UFN
0161 3A 085C            lda     Cdisk
0164 77                 mov     M,A             ;set auto select
0165 ED 5B 0864         lded    String
0169 01 000C            lxi     B,0Ch
016C CD B0                                      ;move UFN to buffer
016E 06 18              mvi     B,18h
0170 AF                 xra     A
0171 12         Blank:  stax    D
0172 13                 inx     D
0173 10 FC              djnz    Blank           ;clear UFN's trailing bytes
0175 ED 53 0864         sded    String
0179 3A 0860            lda     Num
017C 3C                 inr     A
017D 32 0860            sta     Num             ;increment file counter
0180 32 085F            sta     Cnum
0183 0E 12              mvi     C,12h
0185 CD 0005            call    Bdos            ;search for next AFN
0188 3C                 inr     A
0189 20 CB              jrnz    Next
018B 11 04CC            lxi     D,Stmsg         ;no mor AFNs found
018E CD 044D            call    Pstr
0191 11 05EE            lxi     D,Msgd
0194 CD 044D            call    Pstr
0197 CD 04BA            call    Conin           ;check for deletion wanted
019A 20 15              jrnz    Reset           ;jump round if no deletion
019C 3E FF              mvi     A,0FFh
019E 32 0859            sta     Dup             ;set deletion flag
01A1 11 061D            lxi     D,Msgr
01A4 CD 044D            call    Pstr
01A7 CD 04BA            call    Conin           ;if delete, is R/O
01AA 20 05              jrnz    Reset           ;  to be deleted
01AC 3E FF              mvi     A,0FFh
01AE 32 085B            sta     Ro              ;set R/O flag for deletion
01B1 2A 0866    Reset:  lhld    Store
01B4 22 0864            shld    String          ;reset buffer pointer
01B7 CD 0488    Put:    call    Sprint          ;print UFN
01BA CD 04BA            call    Conin
01BD 28 11              jrz     Cok             ;jmp if copy
01BF FE 0D              cpi     CR
01C1 28 23              jrz     Nocop           ;end copy
01C3 FE 0A              cpi     LF
01C5 28 2F              jrz     Gcopy           ;copy rest
01C7 ED 5B 0866         lded    Store           ;set to nocopy
01CB 3E FF              mvi     A,0FFh
01CD 12                 stax    D               ;set drive# to no copy
01CE 18 05              jmpr    Get
01D0 3E FF      Cok:    mvi     A,0FFh
01D2 32 085E            sta     Trans           ;set flag for transfer
01D5 3A 0860    Get:    lda     Num
01D8 3D                 dcr     A               ;decrement file counter
01D9 32 0860            sta     Num
01DC 28 18              jrz     Gcopy           ;stop loop if no more UFNs
01DE 2A 0864            lhld    String
01E1 22 0866            shld    Store
01E4 18 D1              jmpr    Put             ;set next UFN
01E6 3A 0860    Nocop:  lda     Num             ;set rest to nocopy
01E9 2A 0866            lhld    Store
01EC 47                 mov     B,A
01ED 11 0024            lxi     D,24h
01F0 3E FF              mvi     A,0FFh
01F2 77         Ncopy:  mov     M,A             ;set drive # to FFh for nocopy
01F3 19                 dad     D
```

(listing continued on next page)

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*or (LINE FEED) to copy all files from displayed point
– or (RETURN) to skip over all other files
(CNTRL)C to reboot, no copying takes place
Any other key, do not copy displayed file

This is followed by:

DO YOU WISH DUPLICATE FILES DELETED? Y OR N

if this is answered by any other key than Y the file is not transferred if a file of the same name exists on the destination drive, mode 1. Answering Y evokes the message:

DO YOU WISH READ-ONLY FILES DELETED? Y OR N

which allows the user to transfer and remove old files of the same name from the destination drive. Entering Y causes the file including read-only files to be overwritten, mode 3, otherwise only the read-write files will be overwritten, mode 2.

The utility continues by displaying the names of the files matched to the AFN in the command line. The UFNs are displayed in the form:

(source): (UFN). (EXTENSION)?

for example,

B:SAMPLE.TXT?

any of the options, excluding * or Line Feed, may be entered for the first file match. Remember at least one file must be copied using Y before the "copy rest" option may be used, and * or Line Feed may be used.

After running down the list of matched UFNs the message:

COPYING:—

will appear, followed by, in turn, all the UFNs which have been set for copying to the destination drive. During or after copying a multitude of messages may be displayed — see table 1.

If a file of the same name is encountered on the destination directory during a transfer in modes 2 and 3 the utility will form a temporary file of the form:

UFN.(DEL) (DEL) (DEL)

which is used later on in the utility depending on the outcome of the transfer.

If any error messages appear the transfer is terminated. The new file is erased and the temporary file, if present, is renamed and replaced in its original form. Finally the next UFN is accessed. If the transfer is completed with no errors then the new file will automatically take on the attributes of the old file.

Files are transferred in 16K blocks to give a good compromise between size and speed, though this may be altered. The maximum number of disc drives is set by Max in the head of the listing and should be one more than the number of drives available. Another simple alteration is the temporary file extension, found at the head of the listing as Temp. It is set to Delete so that it cannot be entered as a valid file extension from the keyboard. When changing Temp make sure that the character chosen does not clash with any file extension already in use.

The utility does not verify the files transferred because so few errors have been found to occur in practice, and it slows the transfer rate down by several degrees of magnitude. If needed, verification may be added at the position shown in the listing.

Table 1.

Transfer Complete — shows that the copying has been successful.

No More Directory Space — appears if the destination directory was already full before the file is created; the utility is then exited and the system rebooted.

File Exists. No Transfer — is displayed when the UFN is matched to a file in the destination directory, and will only appear when the Deletion prompt is in the "no delete" mode, mode 1.

Duplicate File is Read-Only — appears when in mode 2 and the UFN is matched to a read-only file in the destination directory.

Error messages.

Read Past EOF — a file or directory fault has occurred: the physical size of the file is larger than given by the directory.

Premature EOF — file or directory fault: the file is smaller than expected.

File too Large — the file size is greater than the limit of 64K records.

Empty File — the file has zero size.

Fault in Opening Source — the source file cannot be read for some reason.

Fault In Duplicate File — when in mode 2 or 3 this may occur if the duplicate file cannot be renamed "temporary".

Cannot Delete Existing File — the temporary file cannot be deleted after a successful transfer.

Fault in Closing File — the new file cannot be closed after the transfer has been completed.

(listing continued from previous page)

```
01F4 10 FC              djnz    Ncopy
01F6 3A 085E    Gcopy:  lda     Trans
01F9 3C                 inr     A
01FA C2 0455            jnz     Boot            ;reboot if no transfers
01FD 11 071F            lxi     D,Msg9
0200 CD 044D            call    Pstr
0203 21 086D            lxi     H,Fini
0206 22 0866    Copy:   shld    Store
0209 7E                 mov     A,M
020A 3C                 inr     A               ;see if drive # is FFh
020B CA 0305            jz      Dont
020E AF                 xra     A
020F 32 005A            sta     Rdo
0212 CD 0458            call    Print           ;print file name
0215 01 0020            lxi     B,20h
0218 CD 04A0            call    Tfer            ;setup new FCB
021B 3A 0065            lda     65h
021E E6 7F              ani     7Fh
0220 32 0065            sta     65h             ;set R/O bit to R/W
0223 CD 03AA            call    Check           ;see if file exists
0226 B7                 ora     A
0227 CA 0305            jz      Dont            ;jmp round if error
022A 11 005C            lxi     D,5Ch
022D 0E 16              mvi     C,16h
022F CD 0005            call    Bdos            ;make destination
0232 3C                 inr     A
0233 11 0661            lxi     D,Msg2          ;no more directory space
0236 CA 0452            jz      Error
0239 ED 5B 0866 Made:   lded    Store
023D 0E 0F              mvi     C,0Fh
023F CD 0005            call    Bdos            ;open file
0242 3C                 inr     A
0243 20 09              jrnz    Opened
0245 11 07B7            lxi     D,Msg14         ;can't open
0248 CD 044D            call    Pstr
024B C3 02D2            jmp     Delt
024E ED 5B 0866 Opened: lded    Store
0252 0E 23              mvi     C,23h
0254 CD 0005            call    Bdos            ;get file size
0257 2A 0866            lhld    Store
025A 01 0023            lxi     B,23h
025D 09                 dad     B
025E 7E                 mov     A,M
025F B7                 ora     A
0260 28 09              jrz     Fok
0262 11 07EE            lxi     D,Msg16         ;file > 64K records
0265 CD 044D            call    Pstr
0268 C3 02D2            jmp     Delt
026B 2B         Fok:    dcx     H
026C 56                 mov     D,M
026D 2B                 dcx     H
026E 5E                 mov     E,M
026F 7A                 mov     A,D
0270 B3                 ora     E
0271 20 09              jrnz    Szok
0273 11 0805            lxi     D,Msg17         ;file is empty
0276 CD 044D            call    Pstr
0279 C3 02D2            jmp     Delt
027C ED 53 0868 Szok:   sded    Records         ;save file size
0280 AF                 xra     A
0281 B2                 ora     D
0282 28 13              jrz     Last            ;file < 256 records?
0284 AF         First:  xra     A               ;file >= 256 records
0285 32 0860            sta     Num
0288 32 0861            sta     Num+1
028B CD 035A            call    Rdwrt
028E 3A 0869            lda     Records+1
0291 3D                 dcr     A
0292 32 0869            sta     Records+1
0295 20 ED              jrnz    First
0297 3A 0868    Last:   lda     Records         ;file is < 256 records
029A B7                 ora     A
029B 28 09              jrz     Even
029D 32 0860            sta     Num
02A0 32 0861            sta     Num+1
02A3 CD 035A            call    Rdwrt
02A6 21 1000    Even:   lxi     H,1000h
02A9 CD 0444            call    Admad
02AC ED 5B 0866         lded    Store
02B0 0E 14              mvi     C,14h
02B2 CD 0005            call    Bdos
02B5 B7                 ora     A
02B6 20 09              jrnz    Eof
02B8 11 07B8            lxi     D,Msg3
02BB CD 044D            call    Pstr
02BE C3 02D2            jmp     Delt
02C1 11 005C    Eof:    lxi     D,5Ch
02C4 0E 10              mvi     C,10h
02C6 CD 0005            call    Bdos            ;close file
02C9 3C                 inr     A
02CA 20 4D              jrnz    End
02CC 11 06AB            lxi     D,Msg5          ;error on closing
02CF CD 044D            call    Pstr
02D2 11 005C    Delt:   lxi     D,5Ch
02D5 0E 13              mvi     C,13h
02D7 CD 0005            call    Bdos            ;delete copy
02DA 3A 085A    Reren:  lda     Rdo
02DD B7                 ora     A
02DE 28 25              jrz     Dont
02E0 ED 5B 0864         lded    String
02E4 2A 0864            lhld    String
02E7 01 0010            lxi     B,10h
02EA 09                 dad     B
02EB EB                 xchg
02EC AF                 xra     A
02ED 32 085A            sta     Rdo
02F0 ED 42              dsbc    B
02F2 E5                 push    H
```

```
02F3 EB                 xchg
02F4 ED B0              ldir
02F6 D1                 pop     D
02F7 0E 17              mvi     C,17h
02F9 CD 0005            call    Bdos
02FC 3C                 inr     A
02FD 28 06              jrz     Dont
02FF 11 0797            lxi     D,Msg13
0302 CD 044D            call    Pstr
0305 2A 0866    Dont:   lhld    Store           ;move to next file
0308 01 0024            lxi     B,24h
030B 09                 dad     B
030C 3A 085F            lda     Cnum
030F 3D                 dcr     A
0310 32 085F            sta     Cnum
0313 C2 0206            jnz     Copy
0316 C3 0455            jmp     Boot
0319 01 000B    End:    lxi     B,0Bh
031C CD 04A0            call    Tfer
031F 3A 0065            lda     65h
0322 E6 80              ani     80h
0324 20 08              jrnz    Notro
0326 11 005C            lxi     D,5Ch
0329 0E 1E              mvi     C,1Eh
032B CD 0005            call    Bdos            ;set file attributes
032E 3A 085A    Notro:  lda     Rdo
0331 B7                 ora     A
0332 28 1D              jrz     Comp
0334 21 0065            lxi     H,65h
0337 3E 7F              mvi     A,Temp
0339 77                 mov     M,A
033A 23                 inx     H
033B 77                 mov     M,A
033C 23                 inx     H
033D 77                 mov     M,A
033E 11 005C            lxi     D,5Ch
0341 0E 13              mvi     C,13h           ;delete temp
0343 CD 0005            call    Bdos
0346 3C                 inr     A
0347 20 08              jrnz    Comp
0349 11 072E            lxi     D,Msg10         ;can't delete temp
034C CD 044D            call    Pstr
034F 18 B4              jmpr    Dont
                Comp:   ;verification can be added at this point
0351 11 0691            lxi     D,Msg4
0354 CD 044D            call    Pstr
0357 C3 0305            jmp     Dont
035A 21 1000    Rdwrt:  lxi     H,1000h
035D CD 0444            call    Admad
0360 ED 5B 0866 Read:   lded    Store
0364 0E 14              mvi     C,14h
0366 CD 0005            call    Bdos            ;read source
0369 B7                 ora     A
036A 28 0A              jrz     Okin
036C F1                 pop     PSW
036D 11 07D8            lxi     D,Msg15
0370 CD 044D            call    Pstr
0373 C3 02D2            jmp     Delt            ;premature EOF
0376 CD 043D    Okin:   call    Addma
0379 3A 0860            lda     Num
037C 3D                 dcr     A
037D 32 0860            sta     Num
0380 20 DE              jrnz    Read
0382 21 1000            lxi     H,1000h
0385 CD 0444            call    Admad
0388 11 005C    Write:  lxi     D,5Ch
038B 0E 15              mvi     C,15h
038D CD 0005            call    Bdos            ;write destination
0390 B7                 ora     A
0391 28 0A              jrz     Okout
0393 F1                 pop     PSW
0394 11 064C            lxi     D,Msg1          ;no more space
0397 CD 044D            call    Pstr
039A C3 02D2            jmp     Delt
039D CD 043D    Okout:  call    Addma
03A0 3A 0861            lda     Num+1
03A3 3D                 dcr     A
03A4 32 0861            sta     Num+1
03A7 20 DF              jrnz    Write
03A9 C9                 ret
03AA 21 0080    Check:  lxi     H,80h           ;see if file exists
03AD CD 0444            call    Admad
03B0 11 005C            lxi     D,5Ch
03B3 0E 11              mvi     C,11h
03B5 CD 0005            call    Bdos
03B8 47                 mov     B,A
03B9 3C                 inr     A
03BA 3E FF              mvi     A,0FFh
03BC C8                 rz                      ;return if don't exist
03BD 3A 0859            lda     Dup
03C0 B7                 ora     A
03C1 CA 0435            jz      Notfer
03C4 78                 mov     A,B
03C5 87                 add     A
03C6 87                 add     A
03C7 87                 add     A
03C8 87                 add     A
03C9 87                 add     A
03CA C6 80              adi     80h
03CC 26 00              mvi     H,0
03CE 6F                 mov     L,A
03CF 3A 085D            lda     Ddisk
03D2 77                 mov     M,A
03D3 22 0864            shld    String
03D6 01 0009            lxi     B,9h
03D9 09                 dad     B
03DA 7E                 mov     A,M
03DB E6 80              ani     80h
03DD 28 1F              jrz     Ren
03DF 3A 085B            lda     Ro
03E2 B7                 ora     A
03E3 7E                 mov     A,M
03E4 CA 042D            jz      Rdonly
03E7 E6 7F              ani     7Fh
03E9 77                 mov     M,A
03EA ED 5B 0864         lded    String
03EE 0E 1E              mvi     C,1Eh
03F0 CD 0005            call    Bdos            ;set file attributes
03F3 3C                 inr     A
03F4 20 08              jrnz    Ren
03F6 11 072E            lxi     D,Msg10
03F9 CD 044D            call    Pstr
03FC AF                 xra     A
03FD C9                 ret
03FE ED 5B 0864 Ren:    lded    String          ;save old file as temp
0402 2A 0864            lhld    String
0405 01 0010            lxi     B,10h
0408 09                 dad     B
0409 EB                 xchg
040A ED B0              ldir
040C 01 0009            lxi     B,9
040F 09                 dad     B
0410 3E 7F              mvi     A,Temp
0412 77                 mov     M,A
0413 23                 inx     H
0414 77                 mov     M,A
0415 23                 inx     H
0416 77                 mov     M,A
0417 ED 5B 0864         lded    String
041B 0E 17              mvi     C,17h
041D CD 0005            call    Bdos
0420 3C                 inr     A
0421 32 085A            sta     Rdo
0424 C0                 rnz
0425 11 0797            lxi     D,Msg13
0428 CD 044D            call    Pstr
042B AF                 xra     A
042C C9                 ret
042D 11 0752    Rdonly: lxi     D,Msg11         ;signal it as R/O
0430 CD 044D            call    Pstr
0433 AF                 xra     A
0434 C9                 ret
0435 11 0776    Notfer: lxi     D,Msg12         ;no transfer
0438 CD 044D            call    Pstr
043B AF                 xra     A
043C C9                 ret
043D 2A 0862    Addma:  lhld    Dmadd           ;next DMA address
0440 01 0080            lxi     B,80h
0443 09                 dad     B
0444 22 0862    Admad:  shld    Dmadd           ;set CP/M DMA address
0447 EB                 xchg
0448 0E 1A              mvi     C,1Ah
044A C3 0005            jmp     Bdos
044D 0E 09      Pstr:   mvi     C,9             ;CP/M print string
044F C3 0005            jmp     Bdos
0452 CD 044D    Error:  call    Pstr
0455 C3 0000    Boot:   jmp     Wboote          ;warm boot
0458 1E 0D      Print:  mvi     E,CR            ;print filename
045A CD 04B0            call    Conout
045D 1E 0A              mvi     E,LF
045F CD 04B0            call    Conout
0462 E5                 push    H
0463 7E                 mov     A,M
0464 C6 40              adi     40h
0466 5F                 mov     E,A
0467 CD 04B0            call    Conout          ;drive #
046A 1E 3A              mvi     E,':'
046C CD 04B0            call    Conout
046F 06 08              mvi     B,8
0471 23         Pout8:  inx     H
0472 5E                 mov     E,M
0473 CD 04B0            call    Conout          ;filename
0476 10 F9              djnz    Pout8
0478 1E 2E              mvi     E,'.'
047A CD 04B0            call    Conout
047D 06 03              mvi     B,3
047F 23         Pout3:  inx     H
0480 5E                 mov     E,M
0481 CD 04B0            call    Conout          ;file extension
0484 10 F9              djnz    Pout3
0486 E1                 pop     H
0487 C9                 ret
0488 CD 0458    Sprint: call    Print
048B 1E 3F              mvi     E,'?'
048D CD 04B0            call    Conout
0490 1E 20              mvi     E,' '
0492 CD 04B0            call    Conout
0495 3E 24              mvi     A,24h
0497 85                 add     L
0498 6F                 mov     L,A
0499 30 01              jrnc    Plus1
049B 24                 inr     H
049C 22 0864    Plus1:  shld    String
049F C9                 ret
04A0 2A 0866    Tfer:   lhld    Store           ;move buffer to FCB at 005Ch
04A3 23                 inx     H
04A4 11 005D            lxi     D,5Dh
04A7 ED B0              ldir
04A9 3A 085D            lda     Ddisk           ;set destination auto-select
04AC 32 005C            sta     5Ch
04AF C9                 ret
04B0 E5         Conout: push    H               ;CP/M output to console
04B1 C5                 push    B
04B2 0E 02              mvi     C,2
04B4 CD 0005            call    Bdos
04B7 C1                 pop     B
04B8 E1                 pop     H
04B9 C9                 ret
04BA 0E 01      Conin:  mvi     C,1             ;CP/M input from console
04BC CD 0005            call    Bdos
04BF E6 5F              ani     5Fh
04C1 FE 03              cpi     3
04C3 20 04              jrnz    Isity
04C5 F1                 pop     PSW
04C6 C3 0455            jmp     Boot            ;reboot if ^C
04C9 FE 59      Isity:  cpi     'Y'             ;compare for YES
04CB C9                 ret

04CC 0D 0A 0A 435tmsg:  db      CR,LF,LF,'CP/M 2.0 COPY UTILITY
                        (no verification).'
     50 2F 4D 20
     32 2E 30 20
     43 4F 50 59
     20 55 54 49
     4C 49 54 59
     20 28 6E 6F
     20 76 65 72
     69 66 69 63
     61 74 69 6F
     6E 29 2E
04F7 0D 0A 0A 4F        db      CR,LF,LF,'OPTIONS:-
     50 54 49 4F
     4E 53 3A 2D
0503 0D 0A 59 20        db      CR,LF,'Y or y to copy displayed file.'
     6F 72 20 79
     20 74 6F 20
     63 6F 70 79
     20 64 69 73
     70 6C 61 79
     65 64 20 66
     69 6C 65 2E
0523 0D 0A 2A 20        db      CR,LF,'* or [LINE-FEED] to copy all files
                        from displayed point'
     6F 72 20 5B
     4C 49 4E 45
     2D 46 45 45
     44 5D 20 74
     6F 20 63 6F
```

(listing continued on next page)

(listing continued from previous page)

```
      70 79 20 61
      6C 6C 20 66
      69 6C 65 73
      20 66 72 6F
      6D 20 64 69
      73 70 6C 61
      79 65 64 20
      70 6F 69 6E
      74
055C 0D 0A 2D 20        db      CR,LF,'- or [RETURN] to skip over
                                all other files'
      6F 72 20 5B
      52 45 54 55
      52 4E 5D 20
      74 6F 20 73
      6B 69 70 20
      6F 76 65 72
      20 61 6C 6C
      20 6F 74 68
      65 72 20 66
      69 6C 65 73
0508 0D 0A 5E 43        db      CR,LF,'^C to reboot, no copying
                                takes place'
      20 74 6F 20
      72 65 62 6F
      6F 74 2C 20
      6E 6F 20 63
      6F 70 79 69
      6E 67 20 74
      61 6B 65 73
      20 70 6C 61
      63 65
050E 0D 0A 41 6E        db      CR,LF,'Any other key, do not
      79 20 6F 74
      68 65 72 20
      6B 65 79 2C
      20 64 6F 20
      6E 6F 74 20
      63 6F 70 79
      20 64 69 73
      70 6C 61 79
      65 64 20 66
      69 6C 65 2E
05DA 0D 0A 24           db      CR,LF,'$'
05DD 0D 0A 46 49Msg:    db      CR,LF,'FILE NOT FOUND$'
      4C 45 20 4E
      4F 54 20 46
      4F 55 4E 44
      24
05EE 0D 0A 44 4FMsgd:   db      CR,LF,'DO YOU WISH DUPLICATE FILES
                                DELETED? Y OR N $'
      20 59 4F 55
      20 57 49 53
      48 20 44 55
      50 4C 49 43
      41 54 45 20
      46 49 4C 45
      53 20 44 45
      4C 45 54 45
      44 3F 20 59
      20 4F 52 20
      4E 20 24
061D 0D 0A 44 4FMsgr:   db      CR,LF,'DO YOU WISH READ-ONLY FILES
                                DELETED? Y OR N $'
      20 59 4F 55
      20 57 49 53
      48 20 52 45
      41 44 2D 4F
      4E 4C 59 20
      46 49 4C 45
      53 20 44 45
      4C 45 54 45
      44 3F 20 59
      20 4F 52 20
      4E 20 24
064C 0D 0A 4E 4FMsg1:   db      CR,LF,'NO MORE FILE SPACE$'
      20 4D 4F 52
      45 20 46 49
      4C 45 20 53
      50 41 43 45
      24
0661 0D 0A 4E 4FMsg2:   db      CR,LF,'NO MORE DIRECTORY SPACE$'
      20 4D 4F 52
      45 20 44 49
      52 45 43 54
      4F 52 59 20
      53 50 41 43
      45 24
067B 20 20 20 20Msg3:   db      '       READ PAST EOF$'
      20 20 20 20
      52 45 41 44
      20 50 41 53
      54 20 45 4F
      46 24
0691 20 20 20 20Msg4:   db      '       TRANSFER COMPLETE$'
      20 20 20 20
      54 52 41 4E
      53 46 45 52
      20 43 4F 4D
      50 4C 45 54
      45 24
06AB 20 20 20 20Msg5:   db      '       FAULT IN CLOSING FILE$'
      20 20 20 20
      46 41 55 4C
      54 20 49 4E
      20 43 4C 4F
      53 49 4E 47
      20 46 49 4C
      45 24
06C9 0D 0A 53 41Msg6:   db      CR,LF,'SAME DRIVE SPECIFIED$'
      4D 45 20 44
      52 49 56 45
      20 53 50 45
      43 49 46 49
      45 44 24
06E0 0D 0A 53 4FMsg7:   db      CR,LF,'SOURCE DRIVE NOT SPECIFIED$'
      55 52 43 45
      20 44 52 49
      56 45 20 4E
      4F 54 20 53
      50 45 43 49
      46 49 45 44
      24
06FD 0D 0A 44 45Msg8:   db      CR,LF,'DESTINATION DRIVE NOT SPECIFIED$'
      53 54 49 4E
      41 54 49 4F
      4E 20 44 52
      49 56 45 20
      4E 4F 54 20
      53 50 45 43
      49 46 49 45
      24
071F 0D 0A 0A 20Msg9:   db      CR,LF,LF,'  COPYING:-$'
      20 43 4F 50
      59 49 4E 47
      3A 2D 24
072E 20 20 20 20Msg10:  db      '       CANNOT DELETE EXISTING FILE$'
      20 20 20 20
      43 41 4E 4E
      4F 54 20 44
      45 4C 45 54
      45 20 45 58
      49 53 54 49
      4E 47 20 46
      49 4C 45 24
0752 20 20 20 20Msg11:  db      '       DUPLICATE FILE IS READ-ONLY$'
      20 20 20 20
      44 55 50 4C
      49 43 41 54
      45 20 46 49
      4C 45 20 49
      53 20 52 45
      41 44 2D 4F
      4E 4C 59 24
0776 20 20 20 20Msg12:  db      '       FILE EXISTS. NO TRANSFER$'
      20 20 20 20
      46 49 4C 45
      20 45 58 49
      53 54 53 2E
      20 4E 4F 20
      54 52 41 4E
      53 46 45 52
      24
0797 20 20 20 20Msg13:  db      '       FAULT IN DUPLICATE FILE$'
      20 20 20 20
      46 41 55 4C
      54 20 49 4E
      20 44 55 50
      4C 49 43 41
      54 45 20 46
      49 4C 45 24
07B7 20 20 20 20Msg14:  db      '       FAULT IN OPENNING SOURCE$'
      20 20 20 20
      46 41 55 4C
      54 20 49 4E
      20 4F 50 45
      4E 4E 49 4E
      47 20 53 4F
      55 52 43 45
      24
07DB 20 20 20 20Msg15:  db      '       PREMATURE EOF$'
      20 20 20 20
      50 52 45 4D
      41 54 55 52
      45 20 45 4F
      46 24
07EE 20 20 20 20Msg16:  db      '       FILE TOO LARGE$'
      20 20 20 20
      46 49 4C 45
      20 54 4F 4F
      20 4C 41 52
      47 45 24
0805 20 20 20 20Msg17:  db      '        EMPTY FILE$'
      20 20 20 20
      45 4D 50 54
      59 20 46 49
      4C 45 24
0818 0D 0A 53 4FMsg18:  db      CR,LF,'SOURCE DRIVE DOES NOT EXIST$'
      55 52 43 45
      20 44 52 49
      56 45 20 44
      4F 45 53 20
      4E 4F 54 20
      45 58 49 53
      54 24
0836 0D 0A 44 45Msg19:  db      CR,LF,'DESTINATION DRIVE DOES NOT EXIST$'
      53 54 49 4E
      41 54 49 4F
      4E 20 44 52
      49 56 45 20
      44 4F 45 53
      20 4E 4F 54
      20 45 58 49
      53 54 24

0859 0001       Dup:    ds      1               ;deletion flag
085A 0001       Rdo:    ds      1               ;file R/O flag
085B 0001       Ro:     ds      1               ;delete R/O flag
085C 0001       Cdisk:  ds      1               ;source disk #
085D 0001       Ddisk:  ds      1               ;destination disk #
085E 0001       Trans:  ds      1               ;transfer flag
085F 0001       Cnum:   ds      1               ;# of files in buffer
0860 0002       Num:    ds      2               ;# of records in file
0862 0002       Dmadd:  ds      2               ;DMA address for read
                                                 and write
0864 0002       String: ds      2               ;)
0866 0002       Store:  ds      2               ;)file buffer pointers
0868 0002       Records:ds      2               ;file size
086A 0003       Stack:  ds      3               ;17 level stack
                Fini:
```

Example run.

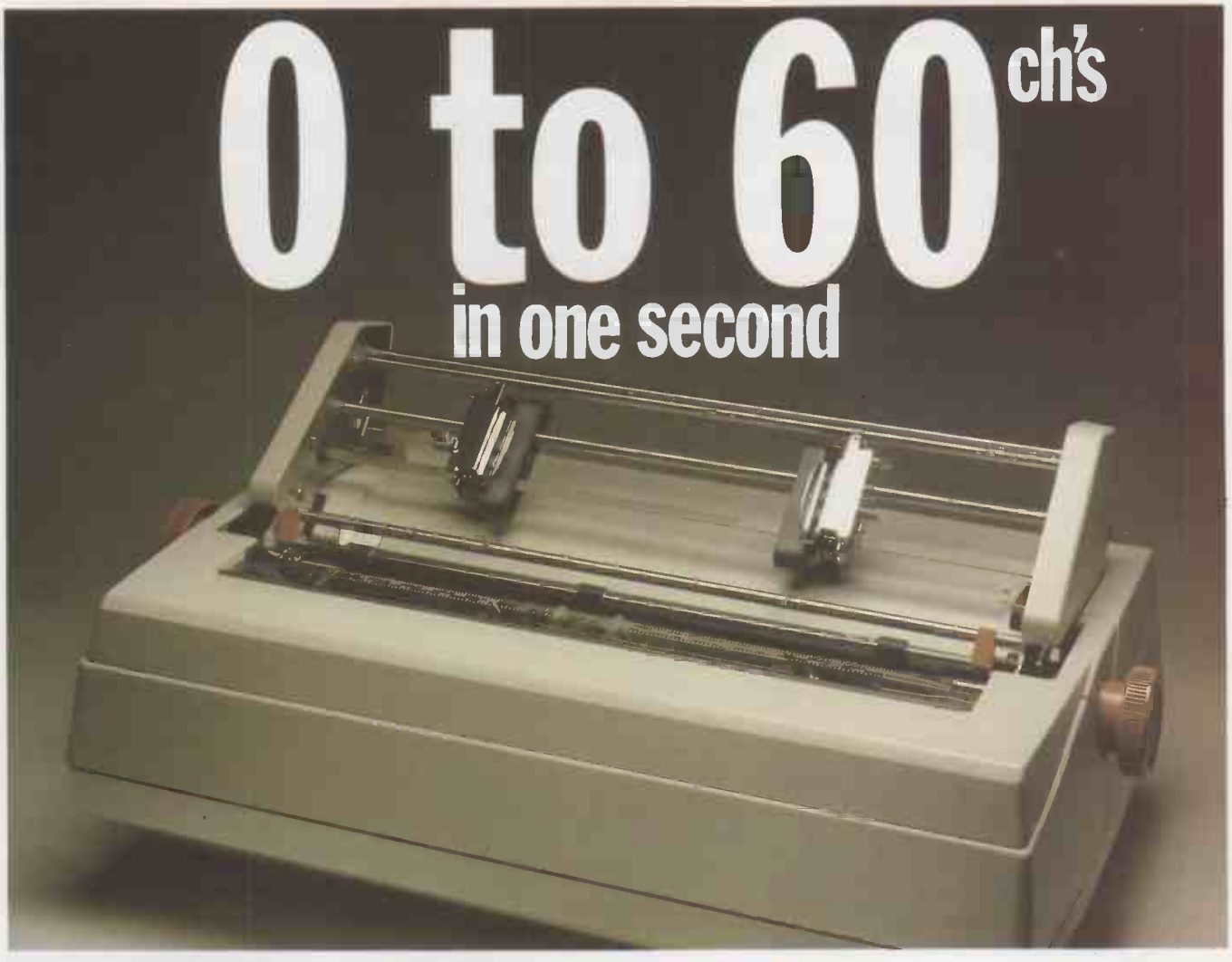
```
B)COPY B:COPY.* A:

CP/M 2.0 COPY UTILITY (no verification).

OPTIONS:-
Y or y to copy displayed file.
* or [LINE-FEED] to copy all files from displayed point
- or [RETURN] to skip over all other files
^C to reboot, no copying takes place
Any other key, do not copy displayed file.

DO YOU WISH DUPLICATE FILES DELETED? Y OR N Y
DO YOU WISH READ-ONLY FILES DELETED? Y OR N N
B:COPY    .SRC? Y
B:COPY    .BAK? N
B:COPY    .COM? Y
B:COPY    .LST? Y

  COPYING:-
B:COPY    .SRC        TRANSFER COMPLETE
B:COPY    .COM        TRANSFER COMPLETE
B:COPY    .LST        TRANSFER COMPLETE
B)
```



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The Ricoh 1600S is available only from Micropute and their authorised dealers, all backed up with a nationwide service network. If you're interested in the 1600S either as a customer or as a dealer, send the coupon now.

"Picture shows 1600s fitted with tractor feed option"

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Tel. No

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FEATURES	COMPETITORS				
	DIABLO 630	QUME SPRINT 5	SPIN-WRITER	RICOH RP.1600 (10 DATA)	**RICOH RP.1600S**
PRINT SPEED (CPS)	40	45/55	55	60	**60**
PRINT ELEMENT	DAISY-WHEEL	DAISY-WHEEL	THIMBLE	DOUBLE DAISY-WHEEL	**DOUBLE DAISY-WHEEL**
AUTO BIDIRECTIONAL	Yes	No	No	No	**Yes**
AUTO LOGIC SEEKING	Yes	No	Yes	No	**Yes**
PROPORTIONAL PRINT CAPABILITY	Yes	Yes	Yes	No	**Yes**
EXTENDED CHARACTER SET	No	No	Yes	Yes	**Yes**
LETTER QUALITY PRINT	Yes	Yes	Yes	Yes	**Yes**
CUSTOM INTER-FACE OPTION	No	No	No	No	**Yes**
PRICE	£1675	£1950	£1950	£1450	**£1450**

The above information was gathered from distributors and abstracted from their current literature. Prices shown are those advertised at the present time.

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IEEE 488 Interface. Connects the OSBORNE 1 to the standard instrumentation bus, for data communication with test instruments.

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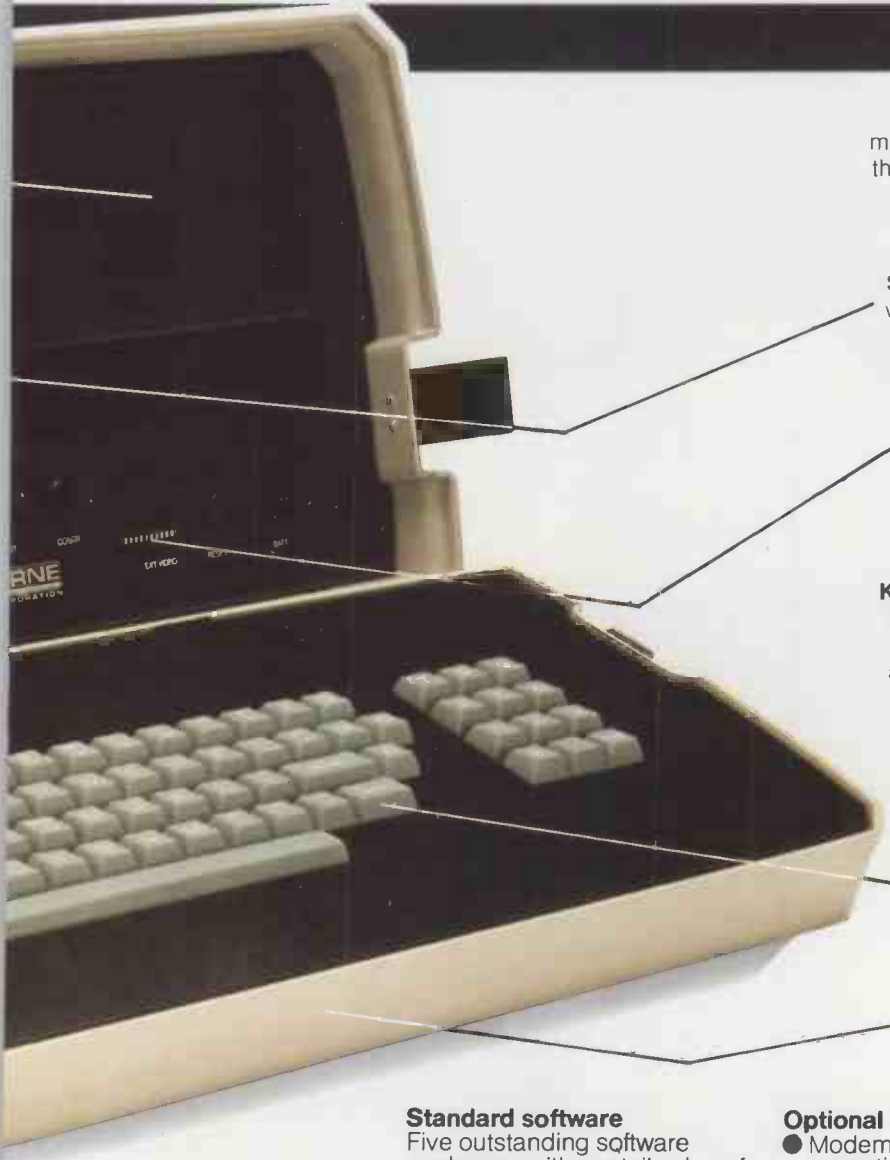

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Though software transmission through Prestel has not made as much progress as had been hoped for, the promotion of telesoftware has been taken in hand by Prestel itself, reports Martin Hayman.

Promotion in hand

PRESTEL'S TELESOFTWARE initiative rolls on. The Prestel-sponsored Aladdin's Cave database has just opened, aiming to be both a telesoftware database and to compile and index the various different IPs who are offering telesoftware and information on microcomputing — including of course, *Practical Telesoftware*. We have not made as much progress over the past month or two as had been hoped — though the promotional aspect of telesoftware has been taken in hand by Prestel itself.

Prestel is now coming under pressure, with many IPs grumbling about the service's lack of acceleration. On the other hand, private viewdata is going well. With the cost of substantial mass storage and processing power dropping week by week in real terms, the potential for running private databases might be seen to pose a threat to the public service.

A DEC TM-3, such as is used by IPC Viewdata, is easily capable of supporting a usefully sized specialist database and can easily be accessed by telephone. Prestel is not the only organisation to have spotted the huge market among microcomputing people for specialist information. If, as seems possible, Prestel wishes to use the microcomputer as a main plank in its marketing platform for the second half of the 1980s, it will certainly face some stiff competition.

It is certainly one way to expand Prestel's market base, which is still clambering painfully towards the 15,000 mark. By contrast, there are more than 300,000 microcomputers in the U.K. today, and their number is rising steadily.

About half of them are Sinclair ZX-81s which though toy-like in appearance are nonetheless capable of being interfaced to Prestel. This much was proved by Martochoice, whose ZX-81 Prestel adaptor was shown at the Earls Court Computer Fair.

The eventual winner was Lion TV, whose adaptor, still at an early stage of development, is said to have potential for use with other micros — including those supporting CP/M. For the argument, let us assume that a device does emerge from the contest which is cheap and reliable and will download CET-format software from Prestel into the ZX. It meets BT connection approval and a deal is set up to produce it. What then?

What is interesting about the enthusiasm displayed by Prestel is that it takes the public service into a totally new area. People are unlikely to be sold on a new technology just because of its newness. What they want is something they can use, and pre-eminently what people want from Prestel is useful information.

By going into the market-place and searching for useful software Prestel is effectively putting itself into the position of the IP, making editorial judgements on what people want to buy. It will have to tackle the tricky problem of satisfactorily remunerating the software author, and if the software is really worthwhile it will have cost the author dear in time. Any sensible author is unlikely to part with it without the assurance either of a lump-sum payment or a solid royalty deal.

Prestel's Tony Sweet is addressing himself to the very problem. So far he has secured the co-operation of the British Apple System Users Group, which has been selecting programs for the Apple and writing uploading software to be used in conjunction with the good old Tantel. It is to be hoped that the programs featured will be more than just Microsource's off-cuts. One sometimes suspects that software products which eventually emerge into the public domain do so because their useful shelf-life has expired.

Apparently a couple of mods are required to interface the Tantel and the Apple satisfactorily: The R58 resistor must be removed from the Microtantal, and the R100 resistor from Apple. Prestel is showing its confidence in the Microtantel/Apple telesoftware interface by supplying the Tantel, connector cable and downloading software for an inclusive price of £150.

T4 viewdata coup

ON A BROADER front, plans for the Information Technology Excellence Centres are shaping up. Based on the Notting Dale Technology Centre, which offers training to the unemployed or otherwise disadvantaged youth of the scruffier end of Notting Hill, the ITECs are an original and ingenious plan for mobilising computing talent. Capital equipment purchase is funded by the Industry Department via Notting Dale, but running costs for staff and training and general upkeep are being sought from sponsors in local industry. The intention is that the ITECs eventually become self-financing — that is to say, they will contract their services out to the local community at the prevailing rate.

Notting Dale has been much in the news over the last year or so. It is reassuring to find some real growth in this particularly broken-down area around Freston Road which some years ago declared itself the "Independent Republic of Frestonia" and is otherwise characteristic of the most dismal inner-city areas of Britain. The squatters, scrap-metal merchants and the kids BMX-ing around the abandoned skateboard park which adjoins the Technology Centre probably know little more of the Technology Centre than the house-high skateboarding mural on its wall, but it sounds like a winner.

The ITECs will be using Technalogics T4 viewdata computers in their first 30 centres. Andrew Polkowski of Techs is over the moon about this coup, as well he might be with the prospect of 70 more orders at £7,000 apiece to follow. Techs has won the order against competition from DEC PDP-11 variants, and the ITECs will use PDP-8, BT-100 computers for general-purpose computing.

The T4 uses the Flex operating system, the 6800 equivalent of CP/M. It can support a hard disc and, interestingly, is designed with an Econet connection specifically for use with the BBC Microcomputer, and developed in collaboration with Acorn. It is also intended to supplement the BBC machine in the areas in which it falls short. The idea is that T4s, especially with a hard disc, should act as local database of useful capacity supplying both telesoftware to remote BBC micros and community information to dumb viewdata terminals, accessing the T4 in the normal way over the telephone. To this end the Notting Dale T4 has three spare ports.

Come to think of it, why bother with a computer at all? A London firm called DataVision is offering a modified telephone answering machine which can successfully capture viewdata-formatted frames. DataVision promises a service creating frames which it will send over the telephone line and will manufacture a closed-loop tape to your own specification giving a repeating sequence of frames for off-line display. Frames can also be lifted from the public service and tailored to your private needs.

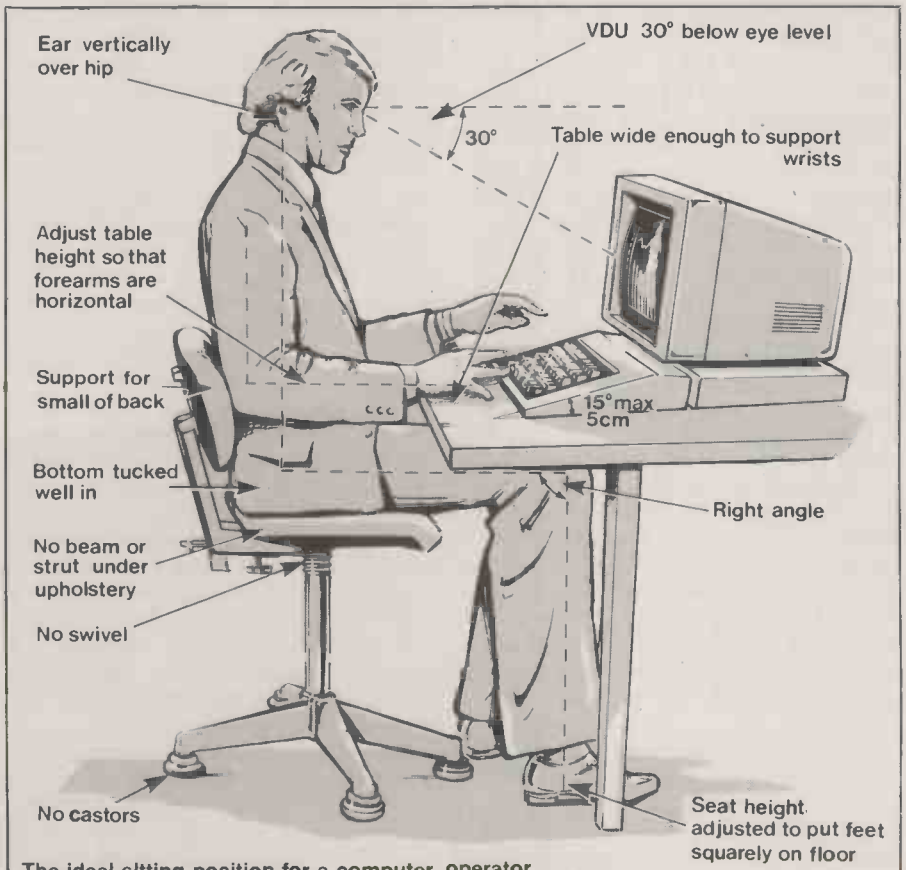
The whole service, described ingeniously as "on-line art direction", is run from an Apple Professional Editing System housed in a Bloomsbury basement. Did someone out there say "privatisation"?

Setting yourself up at the VDU.

- Take a chair without castors or a seat swivel. The instability they produce prevents your muscles relaxing properly.
- Make sure the chair has a short, flat seat that does not unduly press the knee end of the thigh.
- Check that it is soft under the pelvis, and that there are no hidden beams or struts lurking under the upholstery.
- Use a chair with an adjustable support for the small of the back.
- Set the height of the seat so that your feet are squarely on the ground. Alternatively, provide a solid support under your feet to produce this effect.
- Adjust the back rest so that when your bottom is tucked well back into the seat your ear is vertically above your hip. A little of your weight should rest vertically on the back rest.
- Arrange the height of the keyboard so that when the upper arms hang vertically, your lower arms are horizontal.
- Push the keyboard back from the edge of the desk until there is room to rest your wrists.
- The keyboard should be flat enough so that you can operate the keys without raising the wrist from the desk or kinking it upwards.

Computing can damage your health

The strain of suppressing the minor annoyances and physical discomfort of sitting for hours at a VDU exacts a considerable toll in tension and fatigue, explains Philip Latey. Yet these ill-effects can be avoided by proper design of the equipment and its environment — the screen itself, the lighting of the office and even the postcards on the wall all play a part in safeguarding the health of computer users.



The ideal sitting position for a computer operator.

IF KARL MARX had realised how much misery people will put up with, he would have given up before he started. Even with Freud and Melanie Klein detailing the depths of our masochism, there is little reason to be more optimistic.

In my 15 years of subjecting the workplace to close scrutiny I have yet to see one free from inhumanities. The home environment is little better — but that is another story.

Physical factors associated with electronic keyboards and visual displays cause many problems. Our neck, shoulder, head, leg and back aches, along with our migraines, piles, digestive, breathing and bowel disturbances may all have simple aggravating and precipitating factors. What may seem to be a minor nuisance or irritant in the physical environment — easily ignored — can exact a huge toll over the accumulated hours of work. The strain of suppressing this annoyance, however unconscious or unaware we might be, accounts on its own for much tension and fatigue.

Our eyes tire very quickly if forced to focus in one place for any length of time. There should be multiple restful foci in the periphery of the field of vision, muted colours and restful pictures, plants, objects and balanced illumination of the instrument screen so that contrasts are not too harsh.

Non-reflecting glass and a visor, with or without the croupier's green eye shade, are a must; and fluorescent light is unusable with reduplicating image-display or discharge tubes — crossover frequencies and flicker are inevitable. I suggest that 100 cps is the slowest acceptable rate for refreshing the image; some eye responses can be as quick as this.

Paint the walls softly; break up and balance the field of vision; and remove all possible sources of flicker.

All the people sharing the same room or workspace are bound within the confines of small-group relationships. The position of personal workspaces can facilitate work, or disrupt it drastically.

The loose oval seating plan adopted by five or so people meeting for informal discussion is the ideal. Increase their distance from the centre until they are almost out of communication, and put in the desks and apparatus required for their work. Ancillary functions such as

Office paranoia is an all-too-typical result of the unplanned introduction of VDUs.

communal files, rest areas and soft drinks should be widely placed so that people are encouraged to stand up and walk around for at least two minutes in every 20: our bodies resent stasis, and attention-span is limited.

General architectural design must allow for the emergence of these small work groups — and pay special attention to acoustics. Any spillover of ambient sound is irritating; too much hum from poor ventilation systems is fatiguing and hypnotic, as are heavy mechanical actions and very high frequency whine from equipment. Noisy roads, corridors and kitchens can be insulated against.

Good personal space provides individuals with enough privacy and comfort, while making space for the imprint of their personalities. This space surrounds and centres on the seat, work surface and apparatus. Design must start with the seat, progressing to the hand and eye before settling the surroundings. The keyboard and screen should be positioned in relation to the seat and person, rather than the other way round.

Privacy can be completed by closed knee-holes on the desk or table, screens, private cupboards, shelves and places to put up photos and postcards. Mild to moderate paranoia or severe tension is inevitable if this space is open and overlooked from behind. We are territorial cave-dwellers when settling down to work.

The typical office is crammed with wonderful, modern, trendy and attractive features. The concentrated fluorescent barrage illuminates chrome-steel fully floating office chairs.

I would not expect any great change in five, or 25 years time, not in this place: just the usual high turnover of depressed and half-dead slaves; the consumption of NHS time and resources; the endless hypochondriacal remedies for psychosomatic ills; the wrangles for money, time and perks.

One last recommendation. All apparatus should be designed to withstand a hearty thump of rage at least once a day during its useful life.

How to select the best system.

The tone of the VDU screen material and that of the keyboard should be mid-way between screen background and source documents. You can test this by using a photographic exposure meter on the three areas. Bright white or black surrounds and keyboards are not suitable.

A problem arises from the interaction of fluorescent lights and the VDU. Since lights flicker at 100Hz and the VDU is usually refreshed at about 50Hz, it is possible for subliminal but very disturbing beats to occur between the two. The answer is to illuminate the computer with tungsten lights and/or to use a VDU with high-persistence phosphor. Ideally an image should fade away from the screen over a second or so

Dot stability is very important. In tests of eight VDUs from different manufacturers the ratio of peak illumination of dots in an image, to average illumination, ranged from a barely noticeable seven percent up to an irritating 55 percent.

Contrast should be high, for example, in between the legs of the letter "U". In the eight machines tested, the ratio of background illumination to leg illumination ranged from 45 percent (clear) to 13 percent (fuzzy).

Many VDU character sets are badly designed typographically. Letters should be made up of a 9 × 7 matrix and be at least 3.4mm. high. Each letter should be between 2.1 and 3.1mm. wide. The space between capital letters should be at least 0.4mm. If the verticals of letters like M run together it slows down the VDU operator. There should be between 4.3mm. and 8.9mm. space between lines.

The keyboard should slope up as gently as possible. 5° is best, 15° tolerable, so that the user's arms can rest on the desk without kinking the wrists. The middle row of keys should be between 3cm. and 5cm. from the desk.

● Adapted from Fellmann *et al, Behaviour and Information Technology,* 1:1, pp. 69-80 (1982).

Don't let its size fool you.

If anything NewBrain is like the Tardis.

It may look small on the outside, but inside there's an awful lot going on.

It's got the kind of features you'd expect from one of the really big business micros, but at a price of under £200 excluding VAT it won't give you any sleepless nights.

However, let the facts speak for themselves.

You get what you don't pay for.

NewBrain comes with 24K ROM and 32K RAM, most competitors expect you to make do with 16K RAM.

What's more you can expand all the way up to 2 Mbytes, a figure that wouldn't look out of place on a machine costing ten times as much.

We've also given you the choice of 256, 320, 512 and 640 x 250 screen resolution, whereas most only offer a maximum of 256 x 192.

Big enough for your business.

Although NewBrain is as easy as ABC to use (and child's-play to learn to use) this doesn't mean it's a toy.

Far from it.

It comes with ENHANCED ANSI BASIC, which should give you plenty to get your teeth into.

And it'll also take CP/M® so it speaks the same language as all the big business micros, and feels perfectly at home with their software.

NO OTHER MICRO HAS THIS MUCH POWER IN THIS MUCH SIZE FOR THIS MUCH MONEY.

So as a business machine it really comes into its own.

The video allows 40 or 80 characters per line with 25 or 30 lines per page, giving a very professional 2000 or 2400 characters display in all on TV and/or monitor. And the keyboard is full-sized so even if you're all fingers and thumbs you'll still be able to get to grips with NewBrain's excellent editing capabilities.

When it comes to business graphics, things couldn't be easier. With software capabilities that can handle graphs, charts and computer drawings you'll soon be up to things that used to be strictly for the big league.

Answers a growing need.

Although NewBrain, with its optional onboard display, is a truly portable micro, that doesn't stop it becoming the basis of a very powerful system.

The Store Expansion Modules come in packages containing 64K, 128K, 256K or 512K of RAM. So, hook up four of the 512K modules to your machine and you've got 2 Mbytes to play with. Another feature that'll come as a surprise are the two onboard V24 interfaces.

With the aid of the multiple V24 module this allows you to run up to 32 machines at once, all on the same peripherals, saving you a fortune on extras.

The range of peripherals on offer include dot matrix and daisy wheel printers, 9", 12" and 24" monitors plus 5¼" floppy disk drives (100 Kbytes and 1 Mbyte) and 5¼" Winchester drive (6-18 Mbytes).

As we said, this isn't a toy.

It doesn't stop here.

Here are a couple of extras that deserve a special mention.

The first, the Battery Module, means you won't be tied to a 13 amp socket. And, even more importantly, it means you don't have to worry about mains fluctuations wreaking havoc with your programs.

The ROM buffer module gives you a freedom of another sort.

Freedom to expand in a big way. It gives you additional ROM slots, for system software upgrades such as the Z80 Assembler and COMAL, 2 additional V24 ports, analogue ports and parallel ports.

From now on the sky's the limit.

Software that's hard to beat.

A lot of features you'd expect to find on software are actually built into NewBrain so you don't need to worry about screen editing, maths, BASIC and graphics.

However, if you're feeling practical you can always tackle household management, statistics and educational packages. And because NewBrain isn't all work and no play, there's the usual range of mind-bending games to while away spare time.

Waste no more time.

To get hold of NewBrain you need go no further than the coupon at the bottom of the page.

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NEWBRAIN

Open File

This regular section of *Practical Computing* appears in the magazine each month, incorporating Tandy Forum, Apple Pie, ZX-80/81 Line-up and the other software interchange pages.

Open File is the part of the magazine written by you, the readers. All aspects of microcomputing are covered, from games to serious business and technical software, and we welcome contributions on CP/M, BBC Basic, Microsoft Basic, Apple Pascal and so on, as well as the established categories.

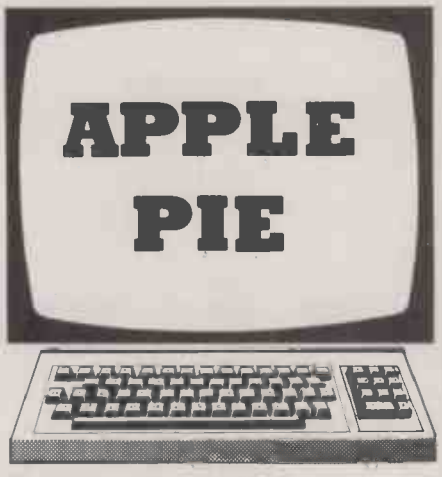
Each month the best contribution will be awarded £20; others receive £6. Send contributions to: Open File, *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

Guidelines for contributors

Programs should be accompanied by documentation which explains to other readers what your program does and, if possible, how it does it. It helps if documentation is typed or printed with double-line spacing — cramped or handwritten material is liable to delay and error.

Program listings should, if at all possible, be printed out. Use a new ribbon in your printer, please, so that we can print directly from a photograph of the listing and avoid typesetting errors. If all you can provide is a typed or handwritten listing, please make it clear and unambiguous; graphics characters, in particular, should be explained.

We can accept material for the Pet, Vic and Sharp MZ-80K on cassette, and material for the larger machines can be sent on IBM-format 8in. floppy discs.



Two-pass assembler

I HAVE RECENTLY devised a two-pass editor-assembler for my Apple II Europlus, writes Sean Overend of Amersham, Buckinghamshire. Output from the assembler is a disc text file containing machine-language op codes and operands, together with addresses into which the code is to be placed.

This text file is largely a sequence of strings of hexadecimal characters representing the addresses and the machine code. In order to load the code, the text file must be input into a loading program which converts the hexadecimal characters into binary numbers, which are then stored appropriately in memory.

The first loading program was written entirely in Basic, and is called Dabbler. Once the assembler program had been written, however, the challenge of rewriting the loading program using the assembler became too great. The second loading program, Dabbler/M, contains machine-code subroutines which were written with the use of the assembler, and is substantially faster than the first version.

The disc text file which stores the output of the assembler program is used as the input to the loading program — see figure 1. It is very similar to the assembled information contained in the printed output of the assembler, such as listing 3. The text file contains information corresponding to the lines of the assembly language program. Each "line" or "record" of information contains:

- The number of bytes of machine code to be loaded for that line.
- The memory address into which the first machine-code byte is to be loaded. The address is stored as a four-character string, using hexadecimal notation.
- One to three bytes of machine-code information, each "byte" consisting of a hexadecimal two-character string.

The task of the loading program is to

(continued on page 135

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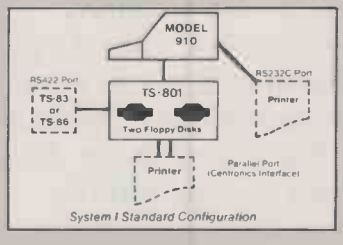

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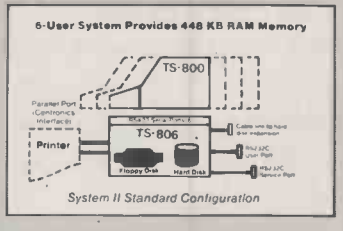

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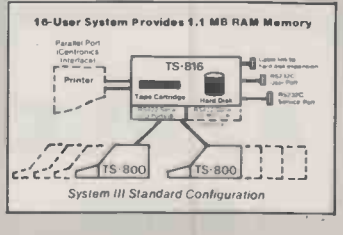

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● Circle No. 186

Assembler, listing 1. Dabbler.

```
0  REM                THE DABBLER PROGRAMME
1 A1 = 7:A2 = 64:A3 = 48:A4 = 16:A5 = 1:A6 =  - 1:A7 = 2:A8 =  - 999
10 D$ = "": REM  CNTRL D
15 OP$ = D$ + "OPEN ":CL$ = D$ + "CLOSE ":RD$ = D$ + "READ ":WR$ = D$ + "WRITE "
20  INPUT "M/C FILE FIRST NAME? ";RA$
25  PRINT OP$;RA$" M/C FILE"
30  PRINT RD$;RA$" M/C FILE"
32 A$(A5) = "":A$(A7) = ""
35  INPUT BN: IF BN = A8 THEN 65
37  INPUT CX$
40  INPUT HX$: IF BN = A5 THEN 55
45  INPUT A$(A5): IF BN = A7 THEN 55
50  INPUT A$(A7)
55  PRINT D$; PRINT CX$" "HX$" ";: IF A$(A5) <  > "" THEN  PRINT A$(A5)" ";: IF A$(A7) <  > "" THEN  PRINT A$(A7);
56  PRINT
57 AX$ = CX$:N = 4: GOSUB 100:PL = AX
58 AX$ = HX$:N = 2: GOSUB 100:PN = AX: POKE PL,PN: IF BN = 1 THEN 64
59 AX$ = A$(1):N = 2: GOSUB 100:PL = PL + 1:PN = AX: POKE PL,PN: IF BN = 2 THEN 64
60 AX$ = A$(2):N = 2: GOSUB 100:PL = PL + 1:PN = AX: POKE PL,PN
64  GOTO 30
65  PRINT CL$;RA$" M/C FILE"
70  END
100  REM  N CHRS OF HEX TO NUMERIC CONVERSION
101  REM  INPUT AX$ CONTAINING N CHRS - OUTPUT IS IN AX
105 AX = 0
110  FOR K = N TO A5 STEP A6
115 X =  ASC ( MID$ (AX$,K,A5))
120 X = X - (A1 * (X > A2)) - A3
125 AX = AX + X * (A4 ^ (N - K))
130  NEXT K
135  RETURN
```

(continued from page 133)

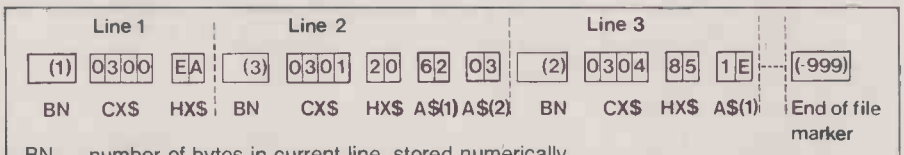
read in information from the disc text file, one line at a time, convert where necessary from string form to numeric form, and then load the converted information into the right part of memory. Variable line lengths are dealt with by making the first element of each line the number of bytes of machine code in the line.

The logic of the Dabbler program is:

- Open the text files.
- Read number of bytes in current line and exit if end-of-file marker −999 encountered. Store in BN.
- Read address for memory loading into CX$ and convert it to PL;
- Read the op code into HX$, and the operands into A$(1) and A$(2). Convert each into numeric form PN and Poke into consecutive memory locations starting at PL.
- Repeat, by going on to next line at stage 2.

As will be seen from the listing of the Dabbler program, it is written entirely in Basic and is inherently slow. Constants have been replaced by variables in places in an attempt to speed up the operation of the program. The subroutine that converts the hexadecimal character string to a numeric form is at lines 100 to 135. Substituting the constants back in, for clarity, gives the following program segment:

```
100 REM HEX CHARACTERS TO
    NUMERIC – (INPUT IN AX$ OF
    LENGTH N AND OUTPUT IN AX)
105 AX = 0
110 FOR K = N TO 1 STEP – 1
115 X = ASC (MID$(AX$,K,1))
120 X=X–(7*(X>42))–48
125 AX=AX+X * (16^(N – K))
130 NEXT K
135 RETURN
```



BN — number of bytes in current line, stored numerically.
CX$ — address into which machine-code information is to be loaded; four-character string in hex.
HX$ — first byte, usually op code; two-character string.
A$(1) and A$(2) — subsequent bytes, usually operands; two-character strings.

Figure 1. Text-file format.

The logic of this subroutine is to derive the ASCII code for each character in turn in the input string, convert to its numeric equivalent, in line 120, and then cumulatively add the product of it and the appropriate power of 16, in line 125. There is no need for an error trap to detect invalid input, as the text file created by the assembler has already been screened for errors. Finally, the converted machine-code bytes are Poked into the appropriate memory locations.

The Dabbler/M loading program replaces the slow conversions and Poke statements with machine-code subroutines. It is about four times as fast as the first program — effectively as fast as it is possible to read in the information from the disc text file. The three machine-code subroutines are contained in a file called M/C Conversion, the assembled printout of which is shown at listing 3.

The loading is still controlled by the Basic program. The sequence of events is as follows:

- Load the M/C Conversion code into memory from a disc file M/C Conversion. This contains: the initialisation main subroutine located at $0300, decimal 768; main subroutine A at $0320, decimal 800; and main subroutine B at $0335, decimal 821.
- Call the machine-code initialisation main subroutine, the object of which is to discover and store the address of the pointers to the program variable, AX$, which is used as the first variable by the Basic program.
- Open the input text file.
- Read the number of bytes in the current line into BN and exit if end-of-file marker encountered.
- Read the four-character memory address string into AX$; and call the machine-code main subroutine A, the object of which is to convert the four-character string into a two-byte memory address, as well as zeroing a counter used to increment the address to zero.
- Read in each two-character string of machine-code information in the current line in turn into AX$; and in each case call the machine-code main subroutine B, the object of which is to convert the two-character string into a numeric byte, increment the value of the memory address by the current value of the counter and then store the numeric byte in the incremented memory address, finally incrementing the counter for future calls of the subroutine.
- Repeat, by going on to the next line at the fourth stage of this procedure.

To understand the precise operation of

(continued on next page)

Assembler, listing 2. Dabber/M.

```
0  REM            THE DABBLER/M PROGRAMME
100 AX$ = ""
105 D$ =  CHR$ (4)
110  PRINT D$;"BLOAD M/C CONVERSION"
115  CALL 768
120  INPUT "M/C FILE FIRST NAME? ";RA$
130  PRINT D$"OPEN "RA$" M/C FILE"
140  PRINT D$"READ "RA$" M/C FILE"
150  INPUT BN: IF BN =  - 999 THEN 240
160  INPUT AX$; PRINT AX$" ";
170  CALL 800
180  FOR I = 1 TO BN
190  INPUT AX$: PRINT AX$" ";
200  CALL 821
210  NEXT I
220  PRINT
230  GOTO 150
240  PRINT D$"CLOSE "RA$" M/C FILE"
250  END
```

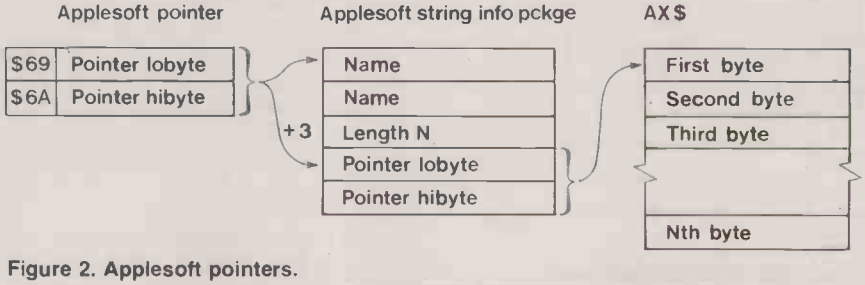


Figure 2. Applesoft pointers.

Assembler, listing 3. M/C conversion.

```
10   0019            BASE  EQU $19          USED TO STORE ADDRESS OF APPLESOFT SECOND POINTERS
20   001B            JAD   EQU $1B          USED TO STORE CURRENT ADDRESS OF BASE OF STRING AX$
30   001D            MEM   EQU $1D          USED TO STORE MEMORY ADDRESS INTO WHICH CODE IS TO BE LOADED
40   001F            COUNT EQU $1F          OFFSET TO MEM FOR CONSECUTIVE LOADS OF CODE
50   0006            TEMP  EQU $6           TEMPORARY STORAGE
60   0300            INIT  EQU $300         'INITIALISATION' SUBROUTINE (DECIMAL 768)
70   0300  A5 69           LDA $69          GETS 2ND POINTER ADDRESS AND STORES IT IN BASE AND BASE+1
80   0302  85 19           STA BASE
90   0304  A5 6A           LDA $6A
100  0306  85 1A           STA BASE+1
110  0308  A5 19           LDA BASE
120  030A  18              CLC
130  030B  69 03           ADC #3
140  030D  85 19           STA BASE
150  030F  90 02           BCC NEXT         CHECK IF PAGE BOUNDARY CROSSED
160  0311  E6 1A           INC BASE+1       AND ADD 1 TO PAGE ADDRESS IF IT HAS
170  0313  60       NEXT   RTS              END OF 'INITIALISATION' SUBROUTINE ##########
180  0314  A0 00    JADR   LDY #0           SUBROUTINE TO FIND THE CURRENT ADDRESS OF THE BASE OF THE AX$ STRING
190  0316  B1 19           LDA (BASE),Y     NEEDS CALLING EACH TIME THE AX$ STRING IS CHANGED
200  0318  85 1B           STA JAD
210  031A  C8              INY
220  031B  B1 19           LDA (BASE),Y
230  031D  85 1C           STA JAD+1
240  031F  60              RTS              END OF THE JADR SUBROUTINE ##########
250  0320  20 14 03  A     JSR JADR         'A' SUBROUTINE (DECIMAL 800) ##########
260  0323  A0 00           LDY #0           GETS 4 CHARACTER STRING FROM AX$-CONVERTS TO A 2 BYTE NUMERIC ADDRESS
270  0325  20 44 03        JSR CONVT        WHICH IS STORED IN MEM AND MEM+1
280  0328  85 1E           STA MEM+1
290  032A  C8              INY
300  032B  20 44 03        JSR CONVT
310  032E  85 1D           STA MEM
320  0330  A0 00           LDY #0
330  0332  84 1F           STY COUNT        RESET COUNT TO ZERO
340  0334  60              RTS              END OF 'A' SUBROUTINE ##########
350  0335  20 14 03  B     JSR JADR         'B' SUBROUTINE (DECIMAL 821) ##########
360  0338  A0 00           LDY #0           GETS 2 CHARACTERS FROM AX$-CONVERTS THEM TO A NUMERIC BYTE
370  033A  20 44 03        JSR CONVT        AND STORES IT IN MEMORY LOCATION MEM+COUNT
380  033D  A4 1F           LDY COUNT
390  033F  91 1D           STA (MEM),Y
400  0341  E6 1F           INC COUNT        THEREAFTER INCREMENTS COUNT
410  0343  60              RTS              END OF 'B' SUBROUTINE ##########
420  0344  B1 1B    CONVT  LDA (JAD),Y      SUBROUTINE THAT GETS 2 CONSECUTIVE BYTES FROM AX$-CONVERTS THEM EACH
430  0346  20 5A 03        JSR CON          AND THEN PLACES THE LEAST SIGNIFICANT NYBBLES TOGETHER IN ONE BYTE
440  0349  0A              ASL
450  034A  0A              ASL
460  034B  0A              ASL
470  034C  0A              ASL
480  034D  29 F0           AND #$F0
490  034F  85 06           STA TEMP
500  0351  C8              INY
510  0352  B1 1B           LDA (JAD),Y
520  0354  20 5A 03        JSR CON
530  0357  05 06           ORA TEMP
540  0359  60              RTS              END OF THE CONVT SUBROUTINE ##########
550  035A  C9 41    CON    CMP #65          SUBROUTINE TO CHANGE HEX ASCII CODES TO NUMERIC
560  035C  30 04           BMI 0/9
570  035E  38       A/F    SEC
580  035F  E9 37           SBC #55
590  0361  60              RTS              ALTERNATIVE EXIT TO CON SUBROUTINE
600  0362  38       0/9    SEC
610  0363  E9 30           SBC #48
620  0365  60              RTS              END OF THE CON SUBROUTINE ##########

  0   0000

  1 0019 BASE 10 0019
  2 001B JAD 20 001B
  3 001D MEM 30 001D
  4 001F COUNT 40 001F
  5 0006 TEMP 50 0006
  6 0300 INIT 60 0313
  7 0313 NEXT 170 0314
  8 0314 JADR 180 0320
  9 0320 A 250 0335
 10 0335 B 350 0344
 11 0344 CONVT 420 035A
 12 035A CON 550 035E
 13 035E A/F 570 0362
 14 0362 0/9 600 0366

TOTAL BYTES 102
```

$ 19		BASE
$ 1A		BASE+1
$ 1B		JAD
$ 1C		JAD+1
$ 1D		MEM
$ 1E		MEM+1
$ 1F		COUNT
$ 6		TEMP

Figure 3. Zero-page work area.

(continued from previous page)

the machine-code subroutines requires a knowledge of the way Applesoft treats strings. Basic strings are entered in the upper reaches of memory, just below Himem. Wherever a fresh string is assigned to a program variable the old string is not replaced or overwritten immediately. Applesoft keeps track of which is the current string for each variable by means of packages of information, which include a set of pointers to the base of the current string — see figure 2.

It is relatively easy to find and use the information package for the first simple variable used in a Basic program. It is to be found starting at the address contained in locations $69 and $6A. This address can be thought of as being pointed at by the contents of $69 and $6A. In other words, Applesoft provides a set of pointers to the base of the information package of the first program variable. Figure 2 shows the nature of the package for a string variable, containing the second set of pointers which point to the base of the current string assigned to that variable. This second set of string pointers is always three and four bytes up from the base of the package.

Assembler, listing 4. M/C create file.

```
0  REM        THE CREATE M/C FILE
100 D$ =  CHR$ (4)
110  INPUT "FIRST NAME FOR M/C FILE? ";RA$
120  PRINT D$;"OPEN "RA$" M/C FILE"
130  INPUT "MEMORY ADDRESS ";AX$
135  IF AX$ = "END" THEN 450
140  IF  LEN (AX$) <  > 4 THEN 130
150  INPUT "OPCODE ";HX$
160  IF  LEN (HX$) <  > 2 THEN 150
170  INPUT "IST OPERAND ";A$(1)
180  IF A$(1) = "" THEN BN = 1: GOTO 400
190  IF  LEN (A$(1)) <  > 2 THEN 170
200  INPUT "2ND OPERAND ";A$(2)
210  IF A$(2) = "" THEN BN = 2: GOTO 400
220  IF  LEN (A$(2)) <  > 2 THEN 200
230 BN = 3
400  PRINT D$;"WRITE "RA$" M/C FILE
410  PRINT BN: PRINT AX$: PRINT HX$:
     IF BN > 1 THEN  PRINT A$(1)
420  IF BN > 2 THEN  PRINT A$(1)
430  PRINT D$
440  GOTO 130
450  PRINT D$;"WRITE "RA$" M/C FILE"
460  PRINT  - 999
470  PRINT D$;"CLOSE "RA$" M/C FILE"
```

In order to have access by a machine-code subroutine which is called within a Basic program to whatever has been currently assigned by Applesoft to a Basic string variable, such as AX$, you must know where to find the second set of string pointers and you must read its contents to ascertain the current address of the string.

From the machine-code programming point of view, the location of the second set of pointers needs to be ascertained only once, and can be achieved in an initialisation subroutine. However, each fresh access by a machine-code subroutine to the contents of AX$ itself requires a preceding check of the value of the second set of pointers to ensure that the correct part of memory is being addressed.

The Init and Jadr subroutines perform these tasks in the M/C Conversion file — see listing 3. Init is called initially by itself; Jadr is called by both main subroutines A and B as the first instruction.

Conversion from hexadecimal characters to numeric is performed by the Convt and Con subroutines. The former obtains a pair of characters from AX$, which are individually converted into numeric by a call of Con, and then joins the two together in one byte by suppressing the unwanted high-order nybbles in each. Con merely deducts 55 from ASCII code, if the character is A to F, and 48 if it is 0 to 9.

(continued on page 139).

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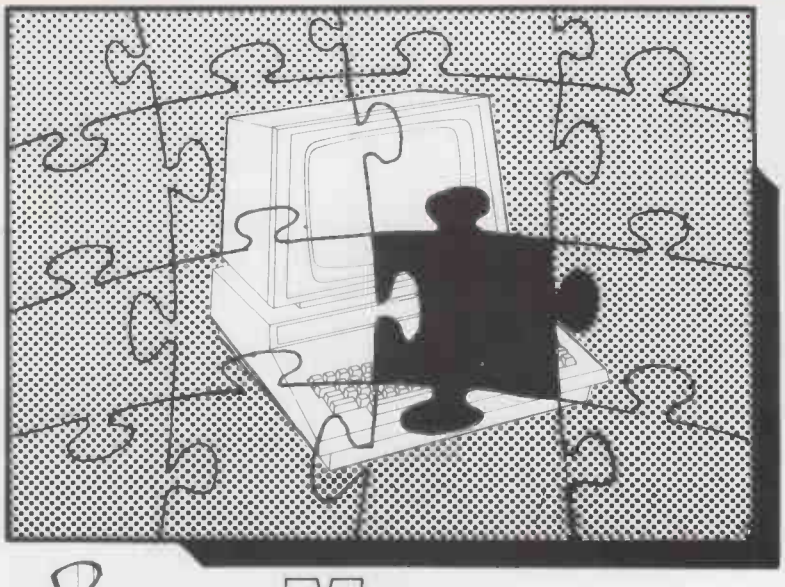

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Print Using.

```
110  REM FILE="FORMAT"
120  REM AUTHOR=B.J.PARKER
130  REM DATE=07/11/81

140  GOTO 240: REM START OF MAIN PROGRAM
150  REM

**PRINT SUBROUTINE**

160  IF ZZ >  = 999999999.2 THEN Z$ =  STR$ (ZZ): GOTO 210
170 Z3 =  ABS (ZZ) + Z6:Z4 =  INT (Z3):Z1$ =  STR$ (Z4)
180 Z2 = Z3 - Z4:Z2$ =  STR$ (Z2): IF Z2 < 0.01 THEN Z2$ = "."
+  MID$ ( STR$ (1 + Z2),3)
190 Z2$ = Z2$ + Z3$: IF  SGN (ZZ) < 0 THEN Z1$ = "-" + Z1$
200 Z$ = Z1$: IF Z2% > 0 THEN Z$ = Z1$ +  LEFT$ (Z2$,Z2%)
210  IF  LEN (Z$) > Z3% THEN Z$ = Z4$
220 ZZ$ =  RIGHT$ ((Z5$ + Z$),Z3%): RETURN
230  REM

**MAIN PROGRAM**

240  CLEAR : TEXT : HOME : NORMAL : SPEED= 255
250 D$ =  CHR$ (4)
260  PRINT D$;"NOMON C,I,O"
270  PRINT D$;"PR#0": REM DISPLAY ON SCREEN
280  REM

**PRINT PARAMETERS**

290  REM SET UP SYMBOL TABLE
300 ZZ = Z3% = Z3 = Z4 = Z2 = Z6 = 0
310 Z$ = "0":Z1$ = "0":Z2$ = "0":Z5$ = "0":Z3$ = "0":Z4$ = "0":Z2$ = "0"
320  REM INACCURATE BEYOND 8 DECIMAL PLACES
330 Z1% = 4: REM NO OF DECIMAL PLACES (USER DEFINED)
340 Z2% = Z1% + 1: IF Z1% < 1 THEN Z2% = 0: REM ALLOW ONE SPACE FOR DECIMAL POINT
350 Z3% = 14: REM NO OF PRINT POSITIONS (USER DEFINED)
360 Z6 = 0.5 / 10 ^ Z1%: REM ROUND UP/DOWN
370 Z6$ = "    FORMAT SPECIFICATION INCORRECT"
380  IF Z1% > (Z3% - 2) OR Z1% < 0 THEN : PRINT  CHR$ (7);Z6$: END
390  FOR J = 1 TO Z3%:Z4$ = Z4$ + "*": NEXT : REM OVERFLOW STRING
400  FOR J = 1 TO Z2%:Z3$ = Z3$ + "0": NEXT : REM PAD TRAILING ZEROS
410  FOR J = 1 TO Z3%:Z5$ = Z5$ + " ": NEXT : REM PAD LEADING BLANKS
420  REM

**DEMO OF ROUTINE**

430  INPUT "START VALUE ? ";QTY
440  FOR J = 1 TO 1000
450 ZZ = QTY
460  GOSUB 160
470  PRINT ZZ$,QTY
480 QTY = QTY * 1.11: NEXT
490  FOR J = 1 TO 20: PRINT  CHR$ (7);: NEXT : REM   BELL
500  END
```

(continued from page 136)

Main subroutine A calls Convt twice in order to get two pairs of characters from AX$ which, when converted, are placed as pointers in Mem and Mem + 1. Main subroutine B gets and converts a pair of characters from AX$ and loads them in the address pointed at by Mem and Mem + 1, incremented by the offset Count.

The workspace areas used by the machine-code subroutines are set out in figure 3. They have been chosen so as not to disrupt Applesoft.

The techniques embodied in the Dabbler/M program, which is really a hybrid between Basic and assembly language, could be adopted in other applications which would benefit from the avoidance of time-consuming Peeks and Pokes. Equally, it is possible to use the loading program on a text file of the right format, not necessarily generated by an assembler.

A simple program to create such a text file is set out in listing 4. It asks for the file's identifier, and thereafter accepts input of the form shown in figure 1. To terminate, type End when asked for a memory address. To skip a request for an operand, press the Return key.

Galaxy Invaders

IN THE LISTING for Galaxy Invaders in June's Apple Pie, the shape table and part of the Basic listing became detached from the rest of the Program, writes Kevin Irving of Carlisle. The missing listings are given here.

Print Using

MANY OF the published Applesoft routines designed to format numbers are either limited to a particular format or very slow to execute, writes Brian Parker of Lancaster. This routine is a general Print Using, which is fast and can handle any number below 999999999.2. Larger numbers are printed in scientific notation.

The routine will print any number of places before the decimal points; print any number of places after the decimal point; print a string of *s when a number overflows the format; right-justify to align the decimal points; and handle all of the quirks in the Applesoft numbering. The number to be formatted is placed in ZZ and returned in ZZ$. The print format is set up using Z1% and Z3%. Lines 290 to 420 set up the print format, and the routine is itself contained in lines 150 to 230. Lines 430 to 500 demonstrate how the routine can be used.

Galaxy Invaders.

```
212  SPEED= 75
213  PRINT "THE ALIENS HAVE RETUR
     NED AND YOU HAVE     BEEN GI
     VEN A NEW COMMANDER .YOU ARE
          INSTRUCTED TO FIGHT OFF
      THE  ALIENS      AGAIN."
214  PRINT "          "; PRINT "
          "; PRINT : PRINT : PRINT

215  SPEED= 255
216  VTAB 23: HTAB 1: PRINT "SCOR
     E ";SC
217  RETURN
```

Shape table.

```
4000- 0B 00 19 00 3D 00 7B 00
4008- 88 00 98 00 B7 00 27 01
4010- 74 01 7F 01 A6 01 00 00
4018- 00 D2 DB 1B 2D 2D 2D 2D
4020- 2D 25 3F 3F 3F 3F 3F 27
4028- 2D 2D 2D 2D 2D 25 3F 3F
4030- 3F 3F 3F 67 49 2D 2D 05
4038- C1 DB 3C 3E 00 39 3F 2C
4040- 2D 3C 3F 07 C1 2D 2D 25
4048- 1F FF 2C 2D 2D 05 C1 DB
4050- FF DB 93 36 36 36 25 24
4058- 24 AC 32 36 25 2C 36 2D
4060- 2D 25 2C 36 25 24 04 C1
4068- 31 36 36 2E 24 24 24 95
4070- 92 DA DB 36 3E DE C1 27
4078- 24 04 00 92 63 0C 1C 1C
4080- 0C 0C 1C 1C 0C 0C 04 00
4088- C1 C1 DB 33 36 4E 89 22
4090- 24 4C 09 C1 C1 36 36 00
4098- 24 24 D4 36 3E 37 2E 2D
40A0- 2D 2D 25 3F 27 97 3A 3F
40A8- 3F 3F BF 09 2D 2D AD 92
40B0- 22 24 64 0E 0E 0E 00 DB
40B8- C1 C1 C1 24 24 24 24 24
40C0- AC 36 36 36 36 36 0E 24
40C8- 24 24 24 24 95 92 32 36
40D0- B6 32 36 36 9E 92 22 24
40D8- 24 24 24 3C C1 B9 36 36
40E0- 36 36 36 F6 24 24 24 24
40E8- 24 24 4C 89 12 24 24 24
40F0- 24 AC 36 36 36 2E C1 C1
40F8- C1 2D 2D 2D 2D 2D 2D 2D
4100- F5 3F 2E 1E DF DB 93 12
4108- 24 24 24 04 C1 DB 1B 2D
4110- 2D 2D 2D 2D 2D 2D E5 3F
4118- 2C C1 E2 DF DB 03 C1 C1
4120- C1 C1 36 36 36 06 00 C1
4128- C1 C1 C1 C1 C1 29 2D 2D
4130- 0C 36 3F 3F 77 09 2D 3E
4138- 37 2D 0D 04 C1 04 C1 04
4140- C1 15 16 16 0E C1 04 C1
4148- 04 C1 15 36 2E 24 2C 36
4150- 96 36 3E 24 3C 36 F6 04
4158- C1 04 C1 17 16 16 1E 04
4160- C1 04 C1 E4 13 36 27 3C
4168- 36 DF 2A 2D 2D 36 07 C1
4170- 3F 3F 3F 00 3C F6 24 3C
4178- 36 3E 24 BC 3E 24 00 D2
4180- DB 3B 07 C1 2D 04 C1 C1
4188- 3F 0C 25 C1 DB 3F 36 3E
4190- 24 BC 32 B7 2A B6 21 24
4198- 35 36 2D 05 C1 C1 C1 C1
41A0- 3F 3F 2C 2D 2D 00 3C 3E
41A8- 04 C1 E2 96 07 C1 24 00
41B0- 00
```

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Hex to Basic

A CONVERTER PROGRAM for the Research Machines 380-Z comes from A M Pennell of Cliftonville, Kent. It converts any hex file, created with the ZASM assembler, into a Basic program consisting of Data statements and a For loop to Poke the code into its correct place. The program will run under any disc-based RML Extended Basic 5, although the machine-code example will only work on monitor Cos 3.4 or later.

The converter program, listing 1, is simple to use. The file name of the existing file is first entered — hex is not required — followed by the file name of the Basic program to be created. These file names are F1$ and F2$, respectively. The line number N of the program being created is incremented in steps of 10, and E is the number of bytes contained in the machine-code routine. These are zeroed in line 110.

Line 120 gets the hex string, H$, from its file, and if it is the first then line 130 sets O$ to the hex origin of the routine. Each hex string is then converted into a Data statement containing up to 16 hex characters. Line 230 checks if the current hex string is the last; so the For loop lines are printed to the Basic file.

As a simple example, the machine-code in listing 2 checks if a printer is connected and on-line, and if it is not, the message "Attend to printer" appears, and the system waits until the fault is corrected before returning to Basic.

Listing 3 shows the assembled listing, listing 4 is of the hex file, and listing 2 is that produced by the program.

Polynomial roots

THIS PROGRAM by Brian Klemz of Brentwood, Essex will compute all the roots of a polynomial equation when written in the form:

$$x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_n = 0.$$

Bairstow's method is used: it searches for two factors of the polynomial equation, one being a quadratic equation, the roots of which were obtained using the formula

$$(-b \pm \sqrt{(b^2 - 4ac)}) \div 2a$$

Bairstow's method is then applied to the remaining factor, a polynomial equation of order n−2. The procedure is repeated until the remaining factor is either a quadratic equation or a single root.

Using a Sharp MZ-80K the program

(continued on next page)

Listing 1. Converter program.

```
10 REM  .HEX TO .BAS CONVERTER
20 REM FOR RML 380Z
30 REM BY A.PENNELL
40 CLEAR 1000
50 INPUT"HEX FILE";F1$
60 F1$=F1$+".HEX"
70 INPUT"BAS FILE";F2$
80 ON EOF GOTO 240
90 OPEN#10,F1$
100 CREATE#10,F2$
110 N=0:E=0
120 INPUT#10,H$
130 IF N=0 THEN O$=MID$(H$,4,4)
140 N=N+10
150 PRINT#10,N;"DATA ";
160 A$=MID$(H$,10,LEN(H$)-10)
170 FOR I=1 TO LEN(A$)-2 STEP 2
180 E=E+1
190 PRINT#10,"&";MID$(A$,I,2);
200 IF I<>LEN(A$)-2 THEN PRINT#10,",";
210 NEXT I
220 PRINT#10
230 IF MID$(H$,2,2)="10" GOTO 120
240 PRINT#10,10+N;"P=&";O$
250 PRINT#10,20+N;"FOR I=P TO P-1+";E
260 PRINT#10,30+N;"READ A:POKE I,A"
270 PRINT#10,40+N;"NEXT I"
280 CLOSE#10
```

Listing 2. Example program.

```
10 DATA &F7,&32,&C0,&21,&15,&C0,&7E,&FE,&FF,&28,&05,&F7,&01,&23,&18,&F6
20 DATA &F7,&32,&28,&FC,&C9,&0D,&41,&74,&74,&65,&6E,&64,&20,&74,&6F,&20
30 DATA &70,&72,&69,&6E,&74,&65,&72,&21,&0D,&FF
40 P=&C000
50 FOR I=P TO P-1+ 42
60 READ A:POKE I,A
70 NEXT I
```

Listing 3. Assembled listing.

```
                ;Z80 ASSEMBLY LISTING OF PRINTER
                ;CHECK ROUTINE FOR RML380Z WITH COS 3.4

C000                    ORG 0C000H      ;ORIGIN
C000 F732               EMT 50          ;LPSTAT
C002 C0                 RET NZ          ;RET IF OK
C003 2115C0             LD HL,DATA      ;PRINT MESSAGE
C006 7E             L1: LD A,(HL)
C007 FEFF               CP 255
C009 2805               JR Z,L2
C00B F701               EMT 1
C00D 23                 INC HL
C00E 18F6               JR L1
C010 F732           L2: EMT 50          ;LPSTAT
C012 28FC               JR Z,L2         ;CHECK AGAIN
C014 C9                 RET             ;RET IF OK

C015 0D             DATA: DEFB 13       ;DATA FOR MESSAGE
C016 41747465           DEFM 'Atte'
C01A 6E642074           DEFM 'nd t'
C01E 6F207072           DEFM 'o pr'
C022 696E7465           DEFM 'inte'
C026 7221               DEFM 'r!'
C028 0DFF               DEFB 13,255

C015 DATA    C006 L1      C010 L2
```

Listing 4. Hex file listing.

```
A>TYPE B:TEST.HEX
:10C00000F732C02115C07EFEFF2805F7012318F680
:10C01000F73228FCC90D41747465E6420746F207A
:0AC020007072696E746572210DFFE5
:0000000000
```

(continued from previous page)

gives reasonably good results. For example, the correct roots of

$x^6 + 6x^5 + 15x^4 + 20x^3 + 15x^2 + 6x + 1 = 0$

are $x = -1$, six times. The computed values are -0.959, -1.04, -0.981, -0.981, -1.022 and -1.022. A computer with a double-precision facility should produce better results.

If the program fails to work the problem can often be overcome by scaling the variable x of the polynomial. For example, it only computes two roots instead of five for the equation

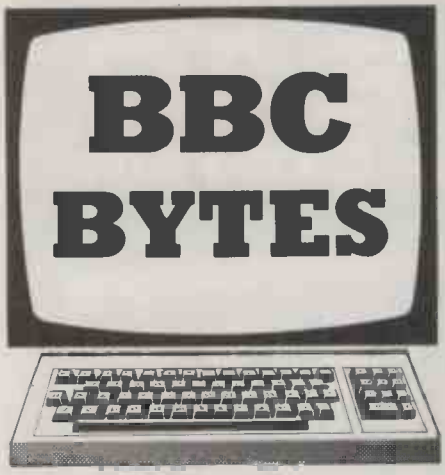
$$x^5 + 1 = 0.$$

However, if the equation is written as

$$X^5 + 32 = 0$$

where $X = 2x$, the computer produces five roots with values for X of $-0.619 \pm j1.902$, $1.618 \pm j1.175$, -2.

```
10 REM REAL AND COMPLEX ROOTS OF A POLYNOMIAL
20 PRINT"@"
30 PRINT"    This programme will compute ALL the roots of a polynomial";
40 PRINT" when expressed in the form:"
50 PRINT:PRINT:PRINT
60 PRINT"      n      n-1      n-2
70 PRINT"     x + a x    + a x    +...a = 0"
80 PRINT"           1        2          n
90 PRINT:PRINT
100 DIMA(10),B(10),C(10),D(10)
110 DEF FNA(Z)=INT(1000*Z)/1000
120 PRINT"ORDER OF POLYNOMIAL(i.e. value of n)";
130 INPUT N
140 PRINT
150 PRINT"TYPE IN THE ";N;"  COEFFICIENTS"
160 PRINT
170 FOR I=1TON
180 PRINT
190 PRINT"coefficient a ="
200 PRINT"                ";I
210 PRINT"■■■■■■■■■■■■■■■■■■■■";
220 INPUT A(I)
230 NEXTI
240 PRINT:PRINT:PRINT
250 IFN<>2THEN 490
260 B=A(1)
270 C=A(2)
280 D=B*B-4*C
290 IFD<0THEN 370
300 D1=SQR(D)
310 R1=(-B+D1)/2
320 R2=(-B-D1)/2
330 PRINT"REAL ROOTS"
340 PRINTTAB(10);"ROOT=";FNA(R1)
350 PRINTTAB(10);"ROOT=";FNA(R2)
360 GOTO470
370 D1=SQR(-D)
380 IFB=0THEN400
390 IFABS(D1/B)<.04THEN440
400 PRINT:PRINT"COMPLEX ROOTS"
410 PRINT"      REAL PART= ";FNA(-B/2)
420 PRINT"IMAGINARY PART= ";FNA(D1/2)
430 GOTO470
440 PRINT:PRINT"REAL ROOTS"
450 PRINTTAB(10);"ROOT=";FNA(-B/2)
460 PRINTTAB(10);"ROOT=";FNA(-B/2)
470 IFN=2THEN970
480 RETURN
490 IFN=1THEN970
500 IFA(N)<>0THEN530
510 PRINT:PRINTTAB(5);"REAL ROOT";A(N)
520 N=N-1
530 REM DIVIDE A(I) BY A QUADRATIC
540 IF(A(N-2)=0)*(A(N-1)=0)THENP=1:Q=1:GOTO590
550 IFABS(A(N-2))<.001THENA(N-2)=.1
560 P=A(N-1)/A(N-2)
570 IFP=0THENP=1/A(N-2)
580 Q=A(N)/A(N-2)
590 B(0)=1
600 B(1)=A(1)-P*B(0)
610 FORI=2TON
620 B(I)=A(I)-P*B(I-1)-Q*B(I-2)
630 NEXTI
640 C(0)=1
650 C(1)=B(1)-P*C(0)
660 FORI=2TON-1
670 C(I)=B(I)-P*C(I-1)-Q*C(I-2)
680 NEXTI
690 P1=C(N-2)
700 P2=C(N-3)
710 P3=C(N-1)-B(N-1)
720 P4=P1
730 F1=B(N-1)
740 F2=B(N)
750 DE=P1*P4-P2*P3
760 IFDE=0 THEN950
770 DP=(F1*P4-P2*F2)/DE
780 DQ=(P1*F2-F1*P3)/DE
790 P=P+DP
800 Q=Q+DQ
810 IF(DP=0)*(DQ=0)THEN830
820 GOTO590
830 REM ITERATION COMPLETED
840 B=P
850 C=Q
860 GOSUB280
870 N=N-2
880 FORI=1TON
890 A(I)=B(I)
900 NEXTI
910 IFN=1THEN960
920 IFN=2THENGOSUB260
930 IFN>2THEN530
940 GOTO970
950 PRINT:PRINT"DETERMINANT IS ZERO!!":GOTO970
960 PRINT:PRINT TAB(5);"REAL ROOT= ";FNA(-A(1))
970 END
```



Perspective graphics.

```
5 REM 3D GRAPHICS BY SIMON REAVILL
10 MODE 4:VDU 19,1,2,0,0,0
20 DIM XY(19,19)
30 FOR Y=1 TO 19
40 FOR X=1 TO 19
50 XY(Y,X)=(SIN(X/2)*30)+(SIN(Y/4)*75)
60 NEXT:NEXT
70 FOR Y=1 TO 17
80 FOR X=1 TO 18
90 IF X=1 THEN MOVE (X+1)*50+Y*20,Y*30+XY(Y+1,X+1)+200
100 DRAW (X+1)*50+Y*20,Y*30+XY(Y+1,X+1)+200
110 IF Y<>17 THEN DRAW (X+1)*50+(Y+1)*20,(Y+1)*30+XY(Y+2,X+1)+200
120 MOVE (X+1)*50+Y*20,Y*30+XY(Y+1,X+1)+200
130 NEXT:NEXT
```

Perspective graphics

THIS THREE-DIMENSIONAL graphics program for the BBC Microcomputer Model A by Simon Reavill of Nottingham works on a grid principle. The elements of array XY(a,b) are distances from the surface of an imaginary slanted grid.

The program calculates the points and then carries out a dot-to-dot operation to create the surface. The program only deals with a single plane and hidden lines are not accounted for. Execution time is 20 to 30 seconds.

The method used ensures positioning of lines in relation to each other, and so "shading" is correct. Lines 90, 100 and 120 contain the same mathematics so it is possible to use the screen editor to full effect, as they are fairly complex lines to type in. Sine functions work well in line 50, so also try

XY(Y,X)=Sin (Y+X)*50
XY(X,Y)=Sin (X/3)*Y*10
XY(Y,X)=(Sin(X/3)*50)+(Sin(Y/3)*50)

Polygon crowd puller

THE SCHOOL at which I teach was presented with a BBC Micro, won for us by three 13-year-old girls, writes Bernard Noyes of Whitwell, Isle of Wight. The problem then remained, how to feed the interest of the pupils.

The "Welcome" tape was not very helpful, with % and @ symbols in the listings and no clue in the book as to what they do.

Program snippets indicated how easy it is to draw shapes on the screen and prompted this program. A measure of its success is the crowd of pupils who stay after school and enjoy learning what used to be a chore.

A regular polygon is drawn on the screen and the pupil is asked the number of sides. A correct answer gains one mark no matter how many attempts it takes. The polygon is then redrawn in order to clear the screen of clutter and the pupil must name the shape. Right first time gives five marks; a second attempt is permitted after a wrong answer, but if it too is wrong the correct name is shown on the screen and must be copied correctly to continue the program.

A full list of the names used is shown at the beginning of the program, but can be omitted if not required by deleting lines 370, 380 and 390.

Polygon.

```
 200 REM 40 col. High res.
 210 MODE 4
 220 PRINT:PRINT
 230 PRINT" POLYGONS"
 240 REM A PROGRAMME THAT DRAWS POLYGONS(3 to 12 sides)
 250 REM No. OF SIDES AND NAME TO BE TYPED BY PUPIL
 260 REM BY B.S.NOYES. DOWNSIDE MIDDLE SCHOOL. I.W.
 270 REM START SCORE
 280 S=0
 290 PRINT"Not a programme about empty Parrot cages but
about shapes with many sides"
 300 PRINT:PRINT"First you must print the number of sides (A
number not a word.)"
 310 FOR W=1 TO 9000:NEXT W
 320 CLS
 330 PRINT
 340 PRINT" Then you will be asked to type the general name
of the shape"
 350 PRINT:PRINT"i.e.'Four sides' is not a square or a
rectangle"
 360 FOR W=1 TO 6000:NEXT W
 370 PRINT:PRINT"The names of the shapes are:-"
 380 PRINT"Triangle, quadrilateral, pentagon, hexagon,
heptagon, octagon, nonagon, decagon, and"
 390 PRINT"dodecagon
 400 PRINT"(You haven't enough time to copy them!)"
 410 FOR W=1 TO 12000:NEXT W
 411 CLS:PRINT:PRINT
 412 PRINT"Please type in your name."
 414 INPUT X$
 420 READ N,N$:IF N<0 THEN GOTO 1000
 430 GOSUB 750
 440 PRINT:PRINT
 450 PRINT"How many sides dos this shape have?"
 460 INPUT A
 470 IF N=A THEN GOTO 560
 480 PRINT"I am afraid that is wrong, ";X$;" Count them."
 490 PRINT"Now try again"
 500 INPUT A
 510 IF N=A THEN GOTO 560
 520 PRINT:PRINT"Oh dear! Still not quite right."
 530 PRINT"Count slowly...Now try again."
 540 INPUT A
 550 IF N<>A THEN 520
 555 REM. ADD ONE TO SCORE
 560 LET S=S+1:PRINT"That is correct"
 570 FOR W=1 TO 2000:NEXT W
 580 GOSUB 750
 590 PRINT:PRINT
 600 PRINT"What is the name of this shape?"
 610 INPUT A$
 620 IF N$=A$ THEN LET S=S+5:GOTO 710
 630 PRINT"You have got it wrong. Please try again"
 640 INPUT A$
 650 IF N$=A$ THEN GOTO 710
 660 PRINT"You have still got it wrong."
 670 PRINT"Copy me. Type ":PRINT N$
 690 IF N$=A$ THEN GOTO 710
 700 CLS:GOTO 660
 710 PRINT"That is correct"
 720 PRINT:PRINT"Your score is now---"; S
 730 FOR W=1 TO 7000:NEXT W
 740 GOTO 420
 750 CLS
 760 XP=500
 770 YP=200
 780 SIDE=1800/N
 790 THETA=2*PI/N
 800 MOVE XP,YP
 810 FOR I=0 TO N-1
 820 XP=XP+SIDE*COS(I*THETA)
 830 YP=YP+SIDE*SIN(I*THETA)
 840 DRAW XP,YP
 870 NEXT I
 880 RETURN
 890 DATA 6,HEXAGON
 900 DATA 4,QUADRILATERAL
 910 DATA 9,NONAGON
 920 DATA 3,TRIANGLE
 930 DATA 5,PENTAGON
 940 DATA 7,HEPTAGON
 950 DATA 10,DECAGON
 960 DATA 12,DODECAGON
 970 DATA 8,OCTAGON
 980 DATA -1,ENDOFDATA
 1000 IF S>50 THEN PRINT"Well done ";X$" You are a
genius!":END
 1010 IF S$>40 THEN PRINT"Almost all right ";X$ ;" Try again
later.":END
 1020 IF S>30 THEN PRINT"Keep trying ";X$;"      You will do
better.":END
 1030 PRINT"Not very good ";X$;" But you can only
improve":END
```

Matrix inversion

THIS PROGRAM by Carl Ross of Portsmouth, Hampshire inverts a real, unsymmetrical matrix in situ. The method used is that of Gauss-Jordon, and is based on an algorithm by LaFara, where the elements on the leading diagonal have been used as pivots. As it stands, the program requires a 16K ZX-81, but if the Rem and other similar statements are removed it is possible to invert a two-by-two matrix on a 1K machine.

After entering the order of the matrix, data is entered from the matrix row by row, from left to right. LaFara's algorithm can be found in *Computer Methods for Science and Engineering*, published by Hayden in 1973.

The program fails if the leading element on the main diagonal is a zero, or if a pivot becomes zero during the process of inversion. When this occurs, the problem can be overcome by interchanging two columns; after the inversion has taken place the two corresponding rows must be interchanged or vice versa. If the i^{th} column and the k^{th} column are interchanged, then after inversion the i^{th} row and k^{th} row must be interchanged. It is impossible to invert a matrix whose determinant is zero, that is a singular matrix.

The time taken to invert a matrix increases roughly in proportion to the cube of the order of the matrix, and the space required by a square matrix increases by the square of the order of the matrix. Thus, if a hand calculator is being used, inverting matrices larger than three by three becomes exceedingly difficult. This is of considerable importance in science, engineering, building, and so on where inverting matrices is very often a prerequisite for certain problems.

On a 16K ZX-81, the "fast" inversion time for typical matrices is as shown in table 1. Dr Ross's program has been awarded £20 as this month's best contribution.

Order	Time
3	2s.
4	3s.
6	7s.
10	26s.
20	3min. 6s.
30	10min. 17s.
40	24min. 14s.
53	56min. 25s.

```
1   REM PROGRAM BY DR.C.T.F. ROSS
2   REM DEPARTMENT OF MECHANICAL ENGINEERING,
3   REM PORTSMOUTH POLYTECHNIC,
4   REM PORTSMOUTH.
5   REM HANTS.
6   REM PO1 3DJ
10  PRINT "INVERSE OF A REAL UNSYMMETRICAL MATRIX"
20  PRINT "ORDER N = ";
30  INPUT N
35  PRINT N
40  DIM A(N,N)
45  PRINT "FEED IN THE MATRIX IN ROWS"
50  FOR I = 1 TO N
55  IF I = 6 THEN CLS
60  PRINT "ROW";I;
70  FOR J = 1 TO N
80  PRINT " COL";J;
90  INPUT A(I,J)
95  PRINT " = "; A(I,J);
100 NEXT J
105 PRINT
110 NEXT I
115 CLS
120 FOR X = 1 TO N
130 LET DI = A(X,1)
140 IF DI = 0 THEN PRINT "MATRIX IS SINGULAR OR PIVOT = 0"
150 FOR Y = 1 TO N-1
160 LET A(X,Y) =A(X, Y+1)/DI
170 NEXT Y
180 LET A(X,N) = 1/DI
190 FOR Z = 1 TO N
200 IF Z = X THEN GOTO 260
210 LET 0 = A(Z,1)
220 FOR Y = 1 TO N-1
230 LET A(Z,Y) = A(Z,Y,1) - 0* A(X,Y)
240 NEXT Y
250 LET A(Z,N) = -0* A(X,N)
260 NEXT Z
270 NEXT X
275 PRINT "THE INVERSE IS"
280 FOR I = 1 TO N
290 FOR J = 1 TO N
300 PRINT A(I,J); "   ";
310 NEXT J
320 PRINT
330 NEXT I
340 PRINT
350 PRINT "PROGRAM BY DR. C.T.F. ROSS"
```

Qudratic regression

REGRESSION is one of the most useful statistical methods of examining scientific, economic or business data, writes D A Jones of Leeds, West Yorkshire, enabling the relation of two or more variables to be described in terms of a mathematical equation. The calculations needed to fit a straight line are fairly simple, but often the data fits a curve far better. Such calculations are considerably more complex and programs to perform them are rarely found except in expensive business software.

This program will do the same job on a ZX-81. It will fit a quadratic equation of the form

$$Y = a + b_1X + b_2X^2$$

Leaving out Rems and some of the Print statements allows it to be squeezed into a 1K machine. It is perfectly suited for use as a subroutine with a graph-plotting program.

The main part prompts the user on entering data. After the equation has been calculated, lines 330 onwards use it to predict Y values for any value of X given. This could be altered to plot the equation in graphical form on the screen.

Before raising a variable to the power in the program, the Abs function is first used to ensure that it is positive. An error message results when negative numbers are used, though this should not be illegal as it is perfectly straightforward mathematics.

```
  3 REM QUADRATIC REGRESSION BY D.A.JONES
 10 LET T=2
 20 LET A=0
 30 LET B=A
 40 LET C=A
 50 LET D=A
 60 LET E=A
 70 LET F=A
 80 LET G=A
 90 LET H=A
100 PRINT "HOW MANY POINTS ?"
110 INPUT N
120 FOR M=1 TO N
130 CLS
140 PRINT "POINT ",M,"ENTER X VALUE"
150 INPUT X
160 PRINT "ENTER Y VALUE"
170 INPUT Y
180 LET A=A+X
190 LET B=B+Y
200 LET C=C+ABS(X)**T
210 LET D=D+ABS(Y)**T
220 LET E=E+ABS(X)**3
230 LET F=F+ABS(X)**4
240 LET G=G+X*Y
250 LET H=H+ABS(X)**T*Y
260 NEXT M
270 LET Z=(C-ABS(A)**T/N)*(F-ABS(C)**T/N)-ABS(E-A*C/N)**T
280 LET I=((F-ABS(C)**T/N)*(G-B*A/N)-(H-B*C/N)*(E-A*C/N))/Z
290 LET J=((C-ABS(A)**T/N)*(H-B*C/N)-(G-B*A/N)*(E-A*C/N))/Z
300 LET Z=B/N-A/N*I-C/N*J
310 CLS
320 PRINT "Y= ";Z;" + ";I;" X + ";J;" X**2"
330 REM CALCULATION OF Y FOR A GIVEN VALUE OF X
340 INPUT X
350 CLS
360 LET Y=Z+I*X+J*ABS(X)**T
370 PRINT "IF X =",X,"THEN Y =",Y
380 GOTO 330
```

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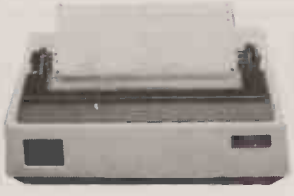

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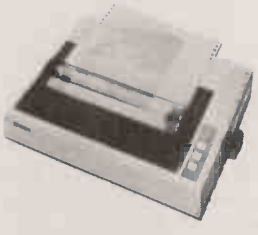

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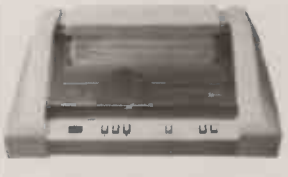

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Simpson's rule

THIS PROGRAM by R Glynn Owens of Wigan, Lancashire calculates area under a normal curve using Simpson's rule for integration. It should prove useful either as a free-standing program or as a subroutine in a larger statistics program.

Lines 1400 and 1500 give the formula for the standard normal curve extending from minus to plus infinity with a mean of zero and a standard deviation of one. The formula is broken into its constituent parts to facilitate modification.

The program can, of course, be used to provide integration under other curves by changing the formula in these two lines. Since it uses a rule which provides approximations, large values of x should be avoided as they will give a result which is rounded to zero.

The program is written for the 8032 Pet but can easily be modified for other machines. For the 40-colum Pets the CHR$(135) in line 2300 should be removed; on the 80-column machine it serves only to give an audible indication that calculation is finished.

Simpson's rule.

```
100 PRINT CHR$(147)
200 PRINT"THIS PROGRAM CALCULATES THE AREA UNDER THE NORMAL CURVE BETWEEN "
300 PRINT"ANY TWO X COORDINATES, USING SIMPSON'S RULE."
400 DIM H(17), O1(18):A1=0
500 PRINT"PLEASE GIVE YOUR TWO X COORDINATES NOW, TYPING RETURN AFTER EACH ONE'
600 INPUT "X(1)";H(1):INPUT"X(2)";H(17):
660 PRINT" ":PRINT" ":PRINT" "
1000 I=(H(17)-H(1))/16
1100 FOR J=2 TO 17
1200 H(J)=H(J-1)+I:NEXT
1300 J=1
1400 H(J)=H(J)↑2:H(J)=H(J)/2:H(J)=-H(J):H(J)=EXP(H(J))
1500 O1(J)=H(J)/SQR(2*3.1415927)
1600 J=J+1
1700 IF (J<18)THEN 1400
1800 FOR L=2 TO 16 STEP 2
1900 A2=A2+O1(L):NEXT:A2=A2*4
2000 FOR L=3 TO 15 STEP 2
2100 A3=A3+O1(L):NEXT:A3=A3*2:A3=A3+A2
2200 A3=A3+O1(1)+O1(17):A=ABS(A3*I/3):A=INT(A*1000):A=A/1000
2300 PRINT CHR$(135),"THE AREA ENCLOSED IS ";A"  OF THE TOTAL"
2400 PRINT"I.E. EXACTLY"A*100 "PERCENT OF THE STANDARD NORMAL CURVE (AREA=1)"
9999 STOP
```

Pig

AS FAR AS I KNOW, this is the first computer program to simulate the game of Pig, claims P Bradshaw of Sunderland, Tyne and Wear. It is an interesting dice game of strategy and luck which is normally played by two opposing humans. In the computer version of the game a solo human plays against the machine. The program will run on any Pet with old, new or 4.0 ROM.

Pig is simple to learn and fun to play. Brief instructions are included in the program and can be omitted or extended as required. The game is played with two dice. Both you, the human player, and the Pet start a game with a score of zero. You and Pet play in turn, with the aim of being the first to reach a total of 100 or more.

When it is your turn, you take control of the dice and roll them one or more times to try to increase your total. If after any roll a 6 shows, your turn ends and nothing is added to your total. If a 6 does not show, you have the option of rolling again, or "sticking". If you stick, your total is incremented by the scores of all the tosses in that turn.

For example, if you throw a 2 and a 3 as the first toss of a turn and then stick, 5 is added to your total. You can choose to roll again, and you get, say, a 5 and a 1, then 11 would be added to your total. If you choose to roll a third time and throw, say, a 2 and a 6, now, because you have thrown a 6, your turn ends and you lose all the points which you otherwise would have won. When your turn has ended, it is the Pet's turn. The computer itself decides when to stick and when to roll again.

The obvious problem in writing a Pig-playing program was that of displaying the dice on the screen. Instead of printing the numbers to the screen, I opted to use the Pet's graphics facilities to draw the dice, greatly increasing the program's visual appeal.

Lines 1200 to 1260 set up a string array D$() which contains graphics characters and cursor-control characters to draw a particular die face on the screen. For example, a 5 is drawn by executing Print D$(5). Two cursor-control strings, D1$ and D2$ are used to move the cursor to the correct position to draw the first and second die respectively.

The subroutine starting at line 1300

(continued on next page)

Pig.

```
100 REM          *** 'PIG' ***
110 REM
120 REM    ** P.BRADSHAW- OCT.1981 **
130 REM
140 REM **RUNS ON ANY PET-8K OR MORE**
150 REM
160 REM
170 MM=144:IFPEEK(60000)=255THENMM=537
180 GOSUB1570:REM INSTRUCTIONS
190 DEFFNA(X)=-((PU<14)OR(RND(1)>.7)OR((YT-(PU+PT))>RND(1)*85))*((PT+PU)<100)
200 X=RND(0)
210 GOSUB1190:GOSUB1490
220 D1$="[illegible]":D2$="[illegible]"
230 SP$="                                    "
240 P$="[illegible]"
250 B$="[illegible]"
260 BU$=CHR$(184):BD$=CHR$(162):FORJ=1TO7:BU$=BU$+BU$:BD$=BD$+BD$:NEXT
270 GOSUB920
280 GOSUB1160
290 GOSUB1180
300 GC=NOTGC:IFGC=-1THENA$="IT'S YOUR TURN TO GO FIRST":GOTO320
310 A$="IT'S MY TURN TO GO FIRST":F1=1
320 GOSUB1270:FORG=1TO2000:NEXT
330 IFGC=0THEN350
340 GOSUB550:REM ***HUMAN TURN***
350 IFW<>0THEN390
360 GOSUB730:REM ***PET TURN***
370 IFW<>0THEN390
380 GOTO340
390 REM *** WIN ROUTINE ***
400 IFW=1THENA$="YOU WIN!":GOSUB1270:YW=YW+1:GOTO420
410 A$="I WIN!":PW=PW+1:GOSUB1270
420 FORF=1TO5000:NEXT
430 PRINT"[illegible]"TAB(10)"[illegible]"LEFT$(BU$,19):PRINTTAB(10)"[illegible] MASTER SCOREBOARD "
440 PRINTTAB(10)"[illegible] ───────────────── "
450 PRINTTAB(10)"[illegible]"LEFT$(SP$,19)
460 PRINTTAB(10)"[illegible]──────────────────"
470 PRINTTAB(10)"[illegible]"LEFT$(SP$,19)
480 PRINTTAB(10)"[illegible]"LEFT$(BD$,19)
490 PRINT"[illegible]"LEFT$(B$,16)"[illegible]YOU="YW
500 PRINT"[illegible]"LEFT$(B$,16)"[illegible]PET="PW
510 PRINT"[illegible]"TAB(7)"DO YOU WANT TO PLAY AGAIN?"
520 GETM$:IFM$<>"Y"ANDM$<>"N"THEN520
530 IFM$="Y"THENYU=0:PU=0:YT=0:PT=0:W=0:GOTO270
540 PRINT"[illegible]":END
550 REM *** HUMAN TURN ***
560 PRINT"[illegible]"LEFT$(P$,19)TAB(15)"OVER"
570 YU=0:GOSUB1160
580 IFYU=0THENA$="PRESS 'SPACE' TO ROLL":GOSUB1270:GOTO600
590 A$="'SPACE' TO ROLL, 'S' TO STICK":GOSUB1270
600 GETM$:IFM$<>""THEN600
610 GETR$:IFR$<>" "AND(R$<>"S"ORYU=0)THEN610
620 A$="":GOSUB1270
630 IFR$="S"THEN700
640 GOSUB1300
```

(listing continued on next page)

(continued from previous page)

rolls the dice randomly, draws them on the screen and returns the score, from two to 12, in variable D. A flag F is set to one if a six has been thrown — line 1380.

The dice, scoreboard and prompt messages all appear on an attractive game board, which is set up at the beginning of a game by the subroutine starting at line 920. The routine uses both Print and Poke. Users of machines other than Pet should note that the Pet screen displays 40 by 25 characters and is mapped into memory locations 32768 to 33767.

The strategy of Pig lies in deciding whether it is worthwhile to stick, or preferable to roll again and risk tossing a 6. The Pet's strategy is defined as a function, FNA, in line 190. This function evaluates to zero if it is worthwhile to stick, or to one if it is worth rolling again.

This function utilises Boolean expressions such as PU>14. It evaluates to zero — false — if PU is 10, or to −1, or true, if PU is 20. Some machines evaluate true as 1: if yours does this, omit the first minus sign in line 190.

There are three variables used in evaluating FNA: YT is the human's total, PT is the Pet's total, and PU is Pet's score for the current turn. The overriding condition of the strategy is that it sticks if it would win by doing so — PT + PU is greater than or equal to 100. Otherwise, it rolls if the score for its turn is less than 14, or if it is trailing behind the human, or if RND(1) exceeds 0.7 to add an element of unpredictability. To make the Pet play more recklessly, decrease the value 0.7 in line 190.

The program includes sound-effects which you can use if you have a user-port soundbox. Sounds are produced when the dice are rolled, and when a 6 is thrown by Poking locations 59467, 59466 and 59464. If you do not have a Pet, you will have to remove sound effects or make appropriate conversions.

The program crashes if the cassette recorder is used after the program has been stopped during a sound effect. The Stop key is therefore disabled while sound effects are in use by Poking location MM, where MM is 537 for an old ROM Pet, or 144 for a new or 4.0 ROM Pet, MM is set to the appropriate value in line 170.

The program uses a short machine-code routine which flashes the border of the game board in an eye-catching way when a 6 is thrown. The routine is Poked into the second cassette buffer in lines 1490 to 1560 and called by SYS 826 in line 1420. This feature is not strictly necessary, and may have to be sacrificed in converting the program to run on a machine other than Pet.

If you cannot muster the energy to type in the program, send £2 and a stamped, addressed envelope to the author at 2 Seaforth Road, Sunderland, Tyne and Wear, SR3 1UX.

(listing continued from previous page)

```
650 IFF=1THEN680
660 YU=YU+D:GOSUB1160
670 GOTO590
680 A$="SORRY!":GOSUB1270:GOSUB1410
690 YU=0:GOSUB1160
700 YT=YT+YU:GOSUB1160
710 IFYT>=100THENW=1
720 RETURN
730 REM *** PET TURN ***
740 QQ=2500:PU=0
750 GOSUB1180
760 PRINT"■"LEFT$(P$,16)TAB(15)"OVER"
770 IFF1=0THENA$="MY TURN!":GOSUB1270:FORG=1TO2000:NEXT
780 IFF1=1THENF1=0
790 PU=0:GOSUB1180
800 IFFNA(0)=0THEN860
810 IFPU>0THENA$="I THINK I'LL ROLL":GOSUB1270
820 FORG=1TO700:NEXT
830 GOSUB1300:IFF=1THEN880
840 A$="":GOSUB1270
850 PU=PU+D:GOSUB1180:FORG=1TO1000:NEXT:GOTO800
860 A$="I'LL STICK":GOSUB1270
870 PT=PT+PU:GOTO890
880 A$="DRAT!":GOSUB1270:GOSUB1410:FU=0:QQ=1
890 GOSUB1180:IFPT>=100THENW=2
900 FORG=1TOQQ:NEXT
910 RETURN
920 REM *** INITIAL DISPLAY ***
930 PRINT"■";
940 FORJ=32768TO33728STEP40
950 FORK=0TO2:POKEJ+K,127:POKEJ+37+K,127:NEXT
960 NEXT
970 FORJ=33688TO33727:POKEJ,127:POKEJ+40,127:NEXT
980 PRINTTAB(9)"■"LEFT$(SP$,21)
990 FORJ=1TO9
1000 PRINTTAB(9)"■ "SPC(19)" "
1010 NEXT
1020 PRINTTAB(9)"■"LEFT$(SP$,21)
1030 PRINT"■"TAB(9)"■"LEFT$(BU$,21)
1040 FORJ=1TO6
1050 PRINTTAB(9)"■"LEFT$(SP$,21)
1060 NEXT
1070 PRINTTAB(9)"■"LEFT$(BD$,21)
1080 PRINT"■■"TAB(14)"■"LEFT$(BU$,11)
1090 PRINTTAB(14)"■ ** PIG ** "
1100 PRINTTAB(14)"■"LEFT$(BD$,11)
1110 PRINTLEFT$(P$,14)TAB(15)"■TURN  TOTAL"
1120 PRINTTAB(15)"■―――――  ―――――"
1130 PRINTTAB(10)"■YOU":PRINTTAB(10)"■――――――――――――――――――"
1140 PRINT"■"TAB(10)"■PET"
1150 RETURN
1160 REM *** DISPLAY SCORES ***
1170 PRINT"■"LEFT$(P$,16)TAB(15)YU"■   "TAB(21)YT"■   ":RETURN
1180 PRINT"■"LEFT$(P$,19)TAB(15)PU"■   "TAB(21)PT"■   ":RETURN
1190 REM *** READ DICE DATA ***
1200 DIM D$(6)
1210 FORJ=1TO6:READX$,Y$,Z$
1220 D$(J)=" ■■■■■ ■■■■■■■■■■"+X$+"■ ■■■■■■■■■■"+Y$+"■ ■■■■■■■■■■"+Z$
1230 D$(J)=D$(J)+"■ ■■■■■■■■■"■■■■■ "
1240 NEXT
1250 FORJ=1TO5:ER$=ER$+"        ■■■■■■■■■":NEXT
1260 RETURN
1270 REM *** DISPLAY TEXT ***
1280 PRINTP$"■■■"LEFT$(SP$,34)
1290 PRINTP$TAB((40-LEN(A$))/2)A$:RETURN
1300 REM *** ROLL DICE ***
1310 PRINTD1$ER$D2$ER$:FORG=1TO200:NEXT
1320 A=INT(RND(1)*6+1):B=INT(RND(1)*6+1):D=A+B
1330 POKEMM,PEEK(MM)+3:POKE59467,16:POKE59464,0:POKE59466,15
1340 PRINTD1$D$(A):POKE59464,133:FORG=1TO100:NEXT:POKE59464,0
1350 FORG=1TO100:NEXT
1360 PRINTD2$D$(B):POKE59464,128:FORG=1TO100:NEXT
1370 POKE59467,0:POKEMM,PEEK(MM)-3
1380 F=-(A=6ORB=6)
1390 RETURN
1400 REM *** SOUND EFFECTS ***.
1410 POKEMM,PEEK(MM)+3:POKE59467,16:POKE59464,0:POKE59466,15
1420 FORJ=1TO12:POKE59464,255:SYS826:FORM=1TO70:NEXT
1430 POKE59464,0:FORM=1TO50:NEXT:NEXT
1440 POKE59467,0:POKEMM,PEEK(MM)-3:RETURN
1450 REM *** DICE DATA ***
1460 DATA"     ","  ●  ","     ","●    ","     ","    ●"
1470 DATA"●    ","  ●  ","    ●","●   ●","     ","●   ●"
1480 DATA"●   ●","  ●  ","●   ●","● ● ●","     ","● ● ●"
1490 REM *** READ MACHINE CODE ***
1500 FORJ=826TO866:READM:POKEJ,M:E=E+M:NEXT
1510 IFE<>5102THENPRINT"■RECHECK THESE LINES:-":LIST1540-1560
1520 RETURN
1530 REM *** MACHINE CODE ***
1540 DATA169,128,141,72,3,141,85,3,160,4,162,0,189,0,132,201,127,240,4
1550 DATA201,255,208,5,73,128,157,0,132,232,208,237,238,72,3,238,85,3,136
1560 DATA208,226,96
1570 REM *** DISPLAY INSTRUCTIONS ***
1580 PRINT"■DO YOU REQUIRE INSTRUCTIONS?"
1590 GETR$:IFR$<>"Y"ANDR$<>"N"THEN1590
1600 IFR$="N"THENRETURN
1610 PRINT"■"TAB(10)"** THE GAME OF PIG **"
1620 PRINT"■■PIG IS A GAME PLAYED WITH TWO DICE IN
1630 PRINT"■WHICH YOU COMPETE AGAINST PET.
1640 PRINT"■TO WIN, YOU MUST ACCUMULATE 100 POINTS
1650 PRINT"■OR MORE BEFORE PET DOES.
1660 PRINT"■■AT THE START OF A GAME, BOTH YOU AND
1670 PRINT"■PET HAVE ZERO POINTS.
1680 PRINT"■YOU AND PET THEN TAKE TURNS TO ATTEMPT
1690 PRINT"■TO INCREASE YOUR TOTAL POINTS.
1700 PRINT"■■PRESS 'SPACE' TO CONTINUE.
1710 GETH$:IFH$<>" "THEN1710
1720 PRINT"■WHEN IT IS YOUR TURN, YOU ROLL THE DICE
1730 PRINT"■ONE OR MORE TIMES TO TRY TO INCREASE
1740 PRINT"■YOUR TOTAL.
1750 PRINT"■IF A SIX SHOWS AFTER ANY ROLL, YOUR TURN
1760 PRINT"ENDS AND NOTHING IS ADDED TO YOUR TOTAL.
1770 PRINT"IF NO SIX SHOWS, YOU MAY EITHER ROLL
1780 PRINT"■AGAIN, OR YOU CAN 'STICK', IN WHICH CASE
1790 PRINT"THE SCORES OF ALL THE TOSSES IN THAT
1800 PRINT"■TURN ARE ADDED TO YOUR TOTAL, AND YOUR
1810 PRINT"■TURN ENDS.
1820 PRINT"■■PRESS 'P' TO PLAY OR 'R' TO READ THE
1830 PRINT"■INSTRUCTIONS AGAIN."
1840 GETH$:IFH$<>"P"ANDH$<>"R"THEN1840
1850 IFH$="R"THEN1610
1860 RETURN
```

Printer initialisation

SENDLST by Max Phillips of Knutsford, Cheshire is an 8080 program to run on any CP/M system. It allows the user to enter a single command line listing a series of ASCII codes to be sent to the printer in order to initialise it. It saves time, paper and temper in comparison with the usual "brute force" method.

The usual way to initialise a modern intelligent printer under a more old-fashioned CP/M is simply to select a printer echo with Control-P, and type the appropriate control codes. This solution is complex and hence prone to error and is rather difficult for non-technical users.

Sendlst ends these problems by allowing you to specify in hex up to 64 ASCII codes to be sent direct to the printer, or any LST device.

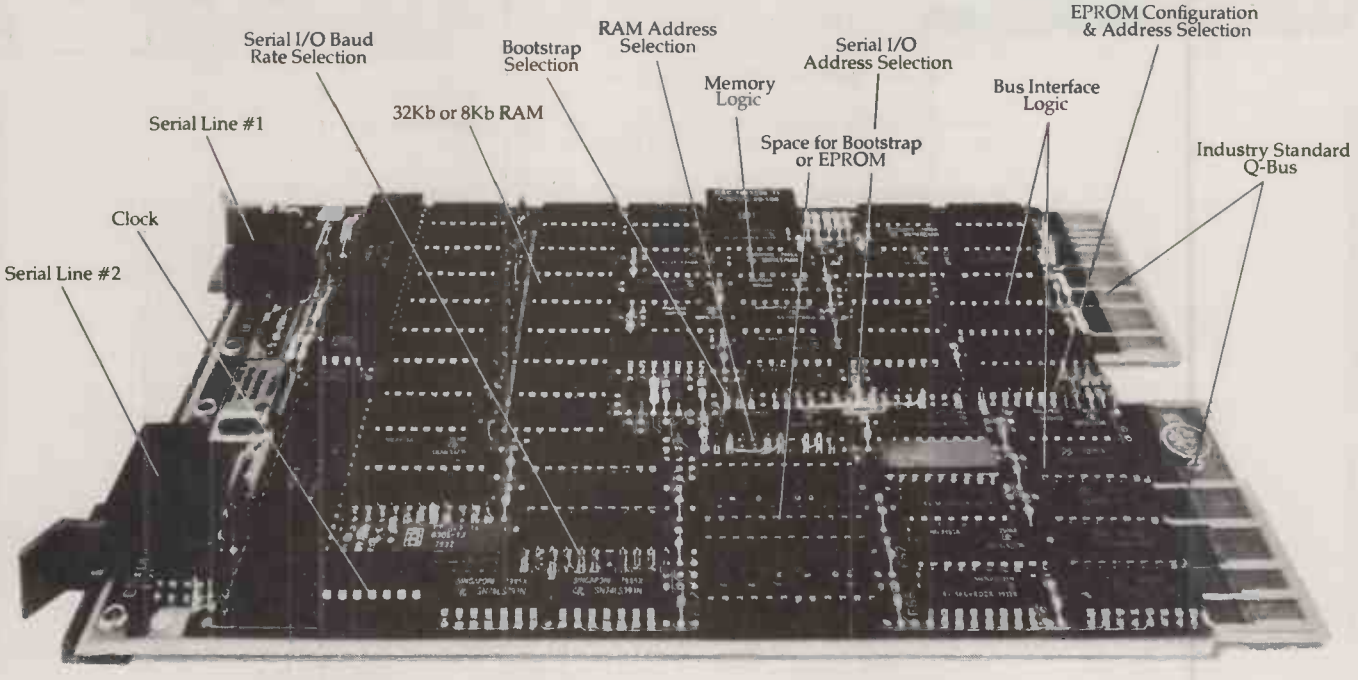
When CP/M's prompt shows, simply type Sendlst followed by a space, the desired hex codes, and Return. For example, to print single sheets of emphasised characters on the Epson MX-80F/T, use

SENDLST 1B450D1B380D

Although this is still formidable to a non-technical user, a list of such commands displayed near the computer makes this solution viable.

```
                ; Program SENDLST source code
                ;
                ; Sends characters given in hex in command line
                ; to the printer (LST device)
                ;
                ; Max Phillips  March '82
                ; struggling with the 8080,CP/M & ASM
                ;
                ; EQUATES
                ;
0000 =          BOOT    EQU 0000H
0005 =          BDOS    EQU 0005H
0080 =          TAIL    EQU BOOT+80H    ; start of tail of command line
                ;
0100                    ORG 100H        ; start of CP/M's Transient program area
                ;
0100 218000             LXI H,TAIL
0103 3A8000             LDA TAIL        ; D reg <- no. of chars typed
0106 57                 MOV D,A
                ;
0107 1E00       LOOP:   MVI E,0         ; clear E reg
0109 CD2201             CALL NEXTCHR    ; get high nybble
010C 07                 RLC
010D 07                 RLC
010E 07                 RLC
010F 07                 RLC
0110 5F                 MOV E,A
0111 CD2201             CALL NEXTCHR    ; get low nybble
0114 B3                 ORA E
0115 5F                 MOV E,A
                ;
                ; Print char in E reg thru' BDOS
                ;
0116 E5                 PUSH H          ; save 8080 registers
0117 D5                 PUSH D
0118 0E05               MVI C, 05H      ; C reg=BDOS code to print E reg to LST
011A CD0500             CALL BDOS
011D D1                 POP D           ; restore registers
011E E1                 POP H
011F C30701             JMP LOOP        ; loop for more characters
                ;
                ; subroutine NEXTCHR
                ;
                ; sets A reg = next valid hex nybble
                ; or returns to CP/M if end of string
                ;
0122 15         NEXTCHR:DCR D
0123 FA0000             JM BOOT         ; restart CP/M if done all characters
0126 23                 INX H
0127 7E                 MOV A,M         ; get next char of command line
0128 EE30               XRI 30H
012A FE0A               CPI 0AH
012C DA3601             JC ISHEX        ; must be digit 0-9
012F C689               ADI 89H
0131 FEFA               CPI 0FAH
0133 DA2201             JC NEXTCHR      ; must be invalid hex char, so try again
0136 E60F       ISHEX:  ANI 0FH
0138 C9                 RET
0139                    END
```

Everything but the kitchen sink.



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Superboard characters

OCCASIONALLY you need to produce large characters made from a matrix of smaller symbols on your video screen, writes Patrick Brampton of Kingsclere, Berkshire. Such characters might be needed in a digital clock program or in a program to produce large animated titles for cine-film or video-recorder.

Large characters could be produced by Poking an area of video memory about five columns wide by seven lines high with blanks and filler characters, to produce the large characters that one wants. If this is done using Basic the characters build up slowly on the screen.

This character-generator subroutine for the Superboard is written in assembler to allow the large characters to be displayed instantaneously. It is written for a 64-column by 30-line Superboard but is easily adaptable to any memory-mapped video system.

Lines 10 to 800 are the subroutine proper, and the hexadecimal code is given for these lines. Lines 810 to 1180 are a table to provide the data for the character generation. You can read the assembled hexadecimal code direct from the table if you require it.

Each character is held in five bytes of data giving a character matrix of five wide by eight high. The characters themselves are only seven elements high, while the eighth is coded blank to provide line spacing. The subroutine generates a sixth blank width element to give lateral spacing. The table as listed codes all decimal digits and the full alphabet. Other characters are easily added if needed.

Parameters are passed to the subroutine by Poking page-zero locations from Basic beforehand. These parameter locations are assigned names in lines 30 to 50.

VDA and VDA+1 must be Poked to hold the low and high byte of the video-memory address of the top, left-hand corner of the character. After generating a character VDA and VDA+1 are adjusted to locate the next character to the right of the one which is just created.

ASCI must be poked with the ASCII code of the character to be generated. As the subroutine stands all ASCII codes except those for 0 to 9 and A to Z generate a space.

If Swit is Poked with zero the generated character is made up of solid block graphics, if Swit is Poked with a non-zero value the large character is made up from the normal-size version of itself. Code, Temp, and Count are working variables.

Lines 100 to 210 reduce the code in ASCI to a number in the range 0 to 35, and lines 220 to 260 multiply this by five to obtain a pointer into the character-code table. Lines 270 to 300 add this offset to the base address of the code table and store it in Code and Code+1. Ideally I would have liked to put a line between 260 and 270 with the instruction:

ADC # <TAB– <TAB/256>*256>

to add in the low byte of the code table address, but my assembler will not do the arithmetic. I have therefore dodged the problem by starting the code table at a whole page boundary at 1F00 hex.

Lines 310 to 800 actually generate the character. The constant in line 500 is the video line length. If other characters are to be added to the code table the constants in lines 120, 140, and 170 may have to be adjusted.

```
10      ;LARGE CHARACTER GENERATOR
20      ;SUBROUTINE ENTRY AT 1E00(HEX)
30                      VDA=$14 ;VIDEO DISPLAY ADDRESS
40                      ASCI=$16;PARK FOR ASCI CODE
50                      SWIT=$17;BLOCK OR CHARACTER SWITCH
60                      CODE=$18;POINTER TO CODE TABLE
70                      TEMP=$1A;COLUMN COUNTER
80                     COUNT=$1B;BIT COUNTER
90                      *=$1E00 ;START ADRESS
100  1E00  A516 BCHAR:  LDA ASCI ;PICK UP ASCII CODE
110  1E02  38           SEC      ;SET CARRY
120  1E03  E930         SBC #$30 ;SUBTRACT ASCII '0'
130  1E05  3009         BMI L11  ;BRANCH IF NOT DIGIT
140  1E07  C90A         CMP #$0A ;TEST IF >'9'
150  1E09  3007         BMI L10  ;BRANCH IF VALID DIGIT
160  1E0B  38           SEC      ;SET CARRY
170  1E0C  E907         SBC #$07 ;TEST IF ALPHABETIC
180  1E0E  1002         BPL L10  ;BRANCH IF >='A'
190  1E10  A9FF     L11:LDA #$FF ;PUT -1 IN ACC
200  1E12  18       L10:CLC      ;CLEAR CARRY
210  1E13  6901         ADC #01  ;FUDGE OFFSET
220  1E15  851A         STA TEMP ;SAVE IN TEMP
230  1E17  0A           ASL A    ;TIMES 2
240  1E18  0A           ASL A    ;TIMES 4
250  1E19  18           CLC
260  1E1A  651A         ADC TEMP ;TIMES 5
270  1E1C  8518         STA CODE ;TABLE OFFSET POINTER
280  1E1E  A91F         LDA #TAB/256 ;MSB TABLE ADDRESS
290  1E20  6900         ADC #00  ;ADD IN CARRY
300  1E22  8519         STA CODE+1;TABLE MSB POINTER
310  1E24  A900         LDA #00  ;ZERO BIT COUNTER
320  1E26  851A         STA TEMP
330  1E28  A41A         LDY TEMP ;ZERO Y-REG
340  1E2A  841B         STY COUNT;ZERO BIT COUNT
350  1E2C  B118     L2:LDA (CODE),Y;GET CODE FROM TABLE
360  1E2E  A000     L7:LDY #00  ;REZERO Y-REG
370  1E30  4A       L4:LSR A    ;ROTATE CODE
380  1E31  48           PHA      ;SAVE ROTATED CODE
390  1E32  B004         BCS L1   ;L1 IF BIT IS SET
400  1E34  A920         LDA #$20 ;POKE VIDEO WITH BLANK
410  1E36  D00A         BNE L8+2 ;ALWAYS BRANCH TO L8+2
420  1E38  A517     L1:LDA SWIT ;TEST SWIT
430  1E3A  F004         BEQ L8
440  1E3C  A9A1         LDA #$A1 ;POKE VDU WITH BLOCK
450  1E3E  D002         BNE L8+2 ;IF SWIT=1
460  1E40  A516     L8:LDA ASCI ;OR ASCI IF SWIT=0
470  1E42  9114         STA (VDA),Y;POKE VDU HERE
480  1E44  98           TYA      ;MOV Y TO AC FOR
490  1E45  18           CLC      ;ARITHMETIC
500  1E46  6940         ADC #$40 ;DROP TO NEXT LINE
510  1E48  A8           TAY      ;RESTORE Y-REG
520  1E49  E61B         INC COUNT;INCREMENT COUNTER
530  1E4B  A51B         LDA COUNT
540  1E4D  C904         CMP #$04 ;FOUR LINES DONE
550  1E4F  D002         BNE *+4  ;BRANCH IF NOT
560  1E51  E615         INC VDA+1;YES-INCREMENT MSB OF VDA
570  1E53  C908         CMP #$08 ;EIGHT LINES DONE
580  1E55  F004         BEQ L3   ;BRANCH IF YES
590  1E57  68           PLA      ;NO-RESTORE ROTATED CODE
600  1E58  4C301E       JMP L4   ;AND CONTINUE
610  1E5B  C615     L3:DEC VDA+1;DECREMENT MSB VDA
620  1E5D  E614         INC VDA  ;INC LSB OF VDA
630  1E5F  D002         BNE *+4
640  1E61  E615         INC VDA+1;CARRY FROM LSB
650  1E63  E61A         INC TEMP ;STEP ON COLUMN COUNTER
660  1E65  A51A         LDA TEMP ;TEST COLUMNS DONE
670  1E67  C905         CMP #$05 ;5 COLUMNS DONE?
680  1E69  F00D         BEQ L6   ;BRANCH TO L6 IF YES
690  1E6B  C906         CMP #$06 ;6 COLUMNS DONE?
700  1E6D  F00F         BEQ OUTX ;IF YES EXIT
710  1E6F  A000         LDY #00  ;REZERO COUNT
720  1E71  841B         STY COUNT
730  1E73  A8           TAY      ;RESTORE Y-REG
740  1E74  68           PLA      ;RESTORE ACC
750  1E75  4C2C1E       JMP L2   ;CONTINUE
760  1E78  68       L6:PLA       ;CLEAN UP STACK
770  1E79  A900         LDA #00  ;LAST COLUMN IS BLANK
780  1E7B  4C2E1E       JMP L7   ;DO IT
790  1E7E  68       OUTX:PLA     ;CLEAN STACK ON EXIT
800  1E7F  60           RTS      ;END OF ROUTINE
810      *=$1F00        ;CHARACTER CODE TABLE
820          TAB:.BYTE 0,0,0,0,0  ;SPACE
830  .BYTE $1C,$22,$41,$22,$1C  ;ZERO
840  .BYTE $00,$42,$7F,$40,$00  ;1
850  .BYTE $42,$51,$61,$49,$46  ;2
860  .BYTE $21,$49,$4D,$2B,$11  ;3
870  .BYTE $18,$14,$12,$7F,$10  ;4
880  .BYTE $27,$45,$45,$29,$11  ;5
890  .BYTE $3E,$49,$49,$49,$32  ;6
900  .BYTE $01,$61,$11,$09,$07  ;7
910  .BYTE $36,$49,$49,$49,$36  ;8
920  .BYTE $26,$49,$49,$49,$3E  ;9
930  .BYTE $7E,$12,$11,$12,$7E  ;A
940  .BYTE $7F,$49,$49,$55,$22  ;B
950  .BYTE $3E,$41,$41,$41,$22  ;C
960  .BYTE $7F,$41,$41,$22,$1C  ;D
970  .BYTE $7F,$49,$49,$49,$41  ;E
980  .BYTE $7F,$09,$09,$09,$01  ;F
990  .BYTE $3E,$41,$41,$51,$32  ;G
1000 .BYTE $7F,$08,$08,$08,$7F  ;H
1010 .BYTE $00,$41,$7F,$41,$00  ;I
1020 .BYTE $20,$41,$41,$3F,$01  ;J
1030 .BYTE $7F,$08,$14,$22,$41  ;K
1040 .BYTE $7F,$40,$40,$40,$40  ;L
1050 .BYTE $7F,$02,$0C,$02,$7F  ;M
1060 .BYTE $7F,$02,$1C,$20,$7F  ;N
1070 .BYTE $3E,$41,$41,$41,$3E  ;O
1080 .BYTE $7F,$09,$09,$09,$06  ;P
1090 .BYTE $3E,$41,$51,$61,$3E  ;Q
1100 .BYTE $7F,$09,$19,$29,$46  ;R
1110 .BYTE $26,$49,$49,$49,$32  ;S
1120 .BYTE $01,$01,$7F,$01,$01  ;T
1130 .BYTE $3F,$40,$40,$40,$3F  ;U
1140 .BYTE $0F,$30,$40,$30,$0F  ;V
1150 .BYTE $7F,$20,$18,$20,$7F  ;W
1160 .BYTE $63,$14,$08,$14,$63  ;X
1170 .BYTE $07,$08,$70,$08,$07  ;Y
1180 .BYTE $61,$51,$49,$45,$43  ;Z
1190 ;
2000            .END
```

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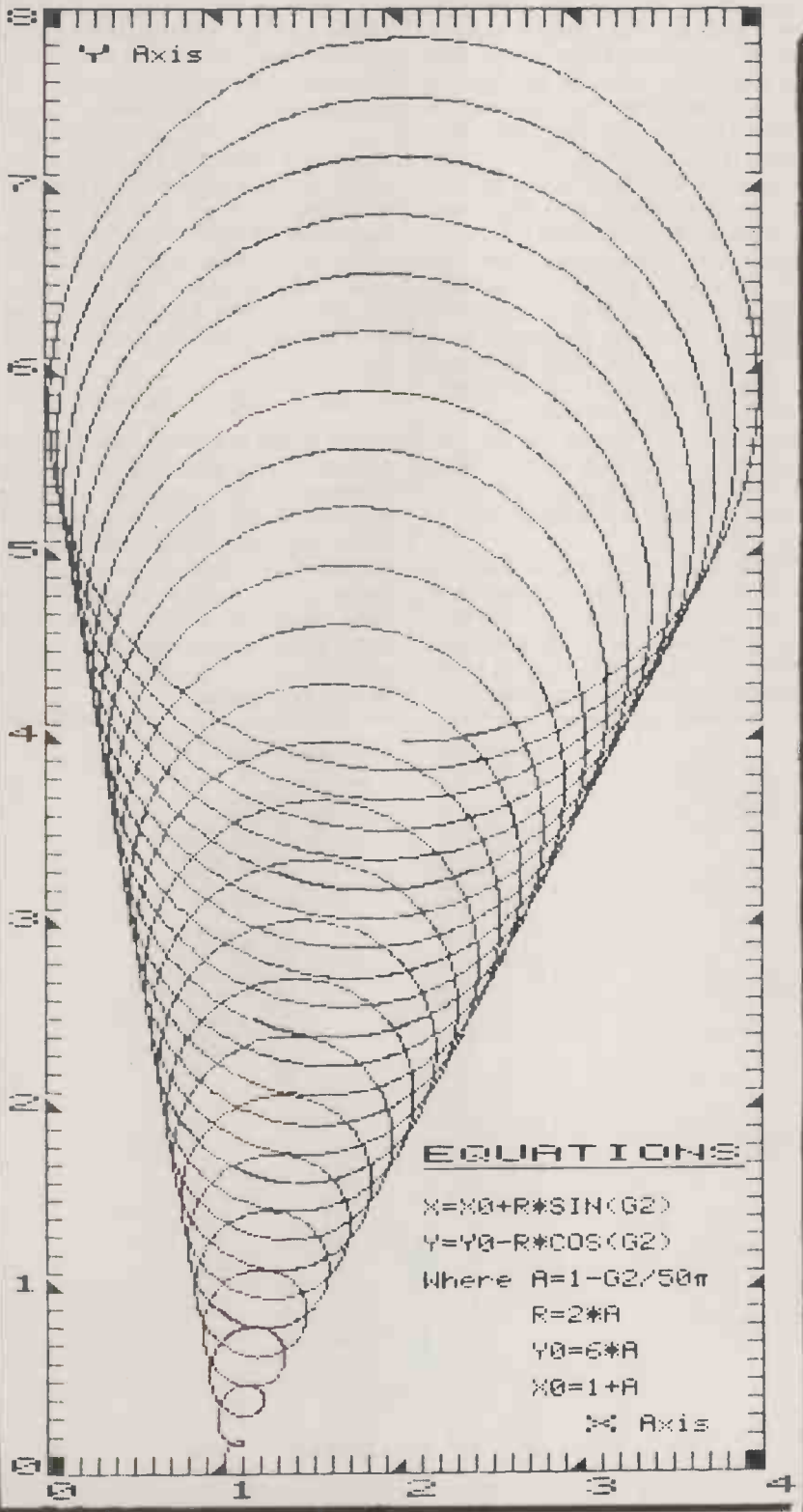

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Formatted listings

I HAVE FOUND several problems with the program listings I get from my printer, writes Andrew Pritchard of Ashtead, Surrey, not the least being that of total illegibility. To produce readable code not only takes a lot of time but also slows down the micro and uses up memory. The TRS-80, unlike many micros, has some useful space-saving features, e.g., multiple statement lines and If-Then-Else, which make the code difficult to read unless the structure of the code is clear. For this reason, and because program lines longer than the printer's character width are lost, I developed a procedure to produce formatted Basic listings.

The program goes through the code in the Basic text area and prints a listing with indents for For-Next loops, puts Ifs and Elses on a new line, separates code from comments and separates key words and line numbers from the rest of the code. The Basic program lists itself in a formatted form, and can be made to list out any Level II program by redefining the Basic text area.

Run the program as follows:

- Type in the formatted-listing program and CSave it on tape.
- Load the program you want listed.
- Change the "start of Basic" pointer to equal the "end of Basic" pointer +3. To do this, stay in command mode and

  POKE 16548, PEEK(16633)+3 : POKE 16549,PEEK(16634)

  Ensure that Peek(16633) is less than 250 otherwise complications arise with having to adjust the most significant byte as well.
- the end-of-Basic pointer must be adjusted by

  POKE 16633,PEEK(16633)+5
- CLoad the formatted-listing program. This can then be Listed, Edited, Saved with no problems.
- Run 100 will produce a formatted listing of the program held in the standard Basic text area.
- Run 50 will restore the original start and end pointers.

The formatting program is listed in formatted form, together with a test program which displays the features of the formatting program. Variables used

(continued on next page)

Formatted listing program.

```
10    STOP :
REM-  RUN COMMAND REQUIRES PARAMETERS
50    IF PEEK (16549)*256+ PEEK (16548)=17129 THEN
         END .
      ELSE
         POKE 16633, PEEK (16548)-3: POKE 16634, PEEK (16549).
         POKE 16548,233. POKE 16549,66. PRINT "RETURNED TO ORIGINAL PROGR
         AM". END .
REM-     "RUN50" RETURNS MACHINE TO NORMAL
100   DEFINT I-Z: DIM N(127). CLS . PRINT "FORMATTED PROGRAM LISTINGS BY
      A.PRITCHARD".
REM-  "RUN100" TO RUN PROGRAM
110   FOR I=5712 TO 6175.
         PV= PEEK (I)
120      IF PV>127 THEN N(CT)=I:CT=CT+1
130   NEXT I.
      TB=6
140   PW=72.
REM-  PW = WIDTH OF PRINTER (# OF CHARACTERS) - 2
145   NW=PW*2/3.
REM-   NW = NORMAL WIDTH FOR EACH PRINTED LINE
150   PN=17129.
REM-  PN SET TO START OF BASIC TEXT
200   LSB= PEEK (PN).MSB= PEEK (PN+1).NX=MSB*256+LSB.
      IF NX=0 THEN END
210   PN=PN+2.LSB= PEEK (PN).MSB= PEEK (PN+1).L$= STR$ (LSB+MSB*256)
220   PN=PN+1.FI=0. GOSUB 1000
230   LPRINT RIGHT$ (L$, LEN (L$)-1),
240   PN=PN+1.PV= PEEK (PN).
      IF PV=0 THEN PN=NX.TB=TB-FI*3. GOTO 200
250   IF NL=1 THEN
         IF PV=135 OR PV=149 OR PV=129 OR PV=143 THEN
            GOSUB 1000
260   IF PV=135 THEN FX=FX-1.TB=F(FX).FF=1
270   IF PV=147 THEN C=5. GOSUB 1000. LPRINT "REM- ";:
         GOTO 240
280   IF (PV>204 AND PV<210) OR (PV>211 AND PV<215) THEN
         VB=2
290   IF PV=149 THEN LPRINT TAB(TB-3)"ELSE";: GOSUB 1000.
         GOTO 240
300   IF NL=0 THEN C=TB.NL=1. LPRINT TAB(TB), VB=1
310   IF PV=10 THEN PV=95.
      ELSE
         IF PV=91 THEN PV=94
320   IF PV<128 THEN VB=0. LPRINT CHR$ (PV), C=C+1:
         GOTO 400.
      ELSE
         IF VB=0 THEN LPRINT " ";:C=C+1:
REM-        WHEN PV GREATER THAN 127 IT IS A KEY WORD
330   LPRINT CHR$ ( PEEK (N(PV-128)) AND 127), CT=1.
      C=C+1
340   CV= PEEK (N(PV-128)+CT).
      IF CV<128 THEN LPRINT CHR$ (CV), C=C+1.CT=CT+1.
         GOTO 340
350   IF VB=2 OR PV=186 THEN VB=0.
      ELSE
         LPRINT " ";:C=C+1.VB=1
400   IF C>PW THEN GOSUB 1000
410   IF PV=129 THEN F(FX)=TB.FX=FX+1.TB=TB+3:FF=1
420   IF PV=143 THEN FI=FI+1.TB=TB+3
430   IF PV=58 OR PV=202 THEN
         IF C>NW OR FF=1 THEN GOSUB 1000
500   GOTO 240
1000  LPRINT CHR$ (10); NL=0.FF=0. RETURN
```

Sample listing — before formatting.

```
100 DIMM(4,5,3):DEFINTA-Z.REMTEST PROGRAM TO DEMONSTRATE A FORMATTED LEVEL I
110 FORI=1TO4:FORJ=1TO5:FORK=1TO3:READM(I,J,K):NEXTK.NEXTJ.PRINT"LEVEL."I"COM
120 CLS.:PRINT OUT VALUES ONTO SCREEN WHICH ARE GREATER THAN 5
130 C=0:FORK=1TO3:PRINT@K*18-5,"SECTOR"K;
140 FORJ=1TO5:FORI=1TO4:SP=K*18+J*64+I*4+115:IFM(I,J,K)>5THENPRINT@SP,"...";
150 NEXTI.NEXTJ:NEXTK:PRINT@704,"NUMBER OF ITEMS BELOW 6 IS"C
1000 DATA1,2,3,4,5,6,7,8,9,9,7,5,6,7,4,3,5,6,7,3,4,5,6,7,2,3,4,5,6,7,8,9,9,9
```

Sample listing — formatted.

```
100   DIM M(4,5,3). DEFINT A-Z:
REM-  TEST PROGRAM TO DEMONSTRATE A FORMATTED LEVEL II LISTING
110   FOR I=1 TO 4:
         FOR J=1 TO 5:
            FOR K=1 TO 3.
               READ M(I,J,K).
            NEXT K.
         NEXT J:
         PRINT "LEVEL."I"COMPLETE".
      NEXT I
120   CLS :
REM-   PRINT OUT VALUES ONTO SCREEN WHICH ARE GREATER THAN 5
130   C=0.
      FOR K=1 TO 3.
         PRINT @K*18-5,"SECTOR"K;
140      FOR J=1 TO 5.
            FOR I=1 TO 4:
               SP=K*18+J*64+I*4+115.
               IF M(I,J,K)>5 THEN PRINT @SP,"...";
                  PRINT @SP, STR$ (M(I,J,K));
               ELSE
                  PRINT @SP+1,"*";:C=C+1
150         NEXT I.
         NEXT J:
      NEXT K.
      PRINT @704,"NUMBER OF ITEMS BELOW 6 IS"C
1000  DATA 1,2,3,4,5,6,7,8,9,9,7,5,6,7,4,3,5,6,7,3,4,5,6,7,2,3,4,5,6,7,8,
      9,9,8,9,6,7,6,5,6,54,6,3,7,3,8,7,6,8,7,5,4,5,6,7,3,4,5,6,73,4,5,5,7
      ,0
```

Shopping check.

```
10    :"A"   :PAUSE "**SHOPPING*****MEMORY**"
             :PAUSE "******INITIALISING******"
             :CLEAR:E=5:B=0
20    :"C"   :E=E+1:IF E=55 PRINT "WARNING..ARRAY NEAR FULL"
25           :INPUT "COST OF ITEM?  ";C
30           :INPUT "NUMBER OF ITEMS?  ";D
             :A(E+50)=D*100+C:INPUT "ITEM NAME?  ";A$(E)
             :B=B+C*D
40           :PRINT "CURRENT TOTAL=";B:GOTO "C"
50    :"F"   :A=6
60           :D=INT(A(A+50)/100):C=A(A+50)-D*100
70           :IF C=0 PRINT "TOTAL BILL=";B:GOTO 70
80           :GOSUB 130:A=A+1:GOTO 60
90    :"S"   :A=6:PAUSE"*****SEARCH FOR ITEM*****"
             :INPUT "COST OF ITEM?  ";C
100          :D=INT(A(A+50)/100):IF D=0 PRINT "SEARCH FAILED":GOTO "S"
110          :IF C=A(A+50)-D*100 GOSUB 130
120          :A=A+1:GOTO 100
130          :PRINT A$(A);" COST=";C;" NO.=";D:RETURN
```

(continued from previous page)

in the program include:

C — character count
TB — indentation Tab value
PV — the Peeked character value
FI — number of nested Ifs
FX — number of nested For-Nexts
FF=1 — line feed required after end of statement line
VB=1 — key word just printed
VB=2 — number spaces around this key word
NL=1 — line feed just sent to printer
F(FX) — For-Next Tab positions

The program always expects only one Next to each For, and cannot cope with more than 10 levels of nested For-Next loops.

Shopping check

HAVE YOU EVER been in a supermarket doing your weekly shopping and wondered whether a mistake has been made at the check-out? Doubtless you are armed with your calculator, writes C T Spracklen of Spennymoor, County Durham, but the problem is that having just loaded all your goods into the trolley, ready to wheel them out to the car, if you do notice a mistake you need to have a recount, and all the items must come out again.

Owners of the Tandy Pocket Computer or Sharp PC-1211 can use this program to move shopping firmly into the 21st century. As you move around the store, each time you place an item in your trolley you enter the cost, number of items and item name into the computer, and the program presents you with a running total. If you notice a mistake at the check-out, pull out your pocket computer and enter the Search mode of the program.

As the assistant calls out the values on the till printout you enter only the cost into the computer. It then searches its memory to see if there are any items present at that price — otherwise it prints Search Failed and you know you have the offending item. If you have more than one item at the same cost, press Return after an item is located to continue the search.

Another way of conducting the search is to use the F — Finished — routine, which scrolls through all of the items on the list one by one as you tick them off the till roll. Owners of the printer can use this routine to produce a printout of the items.

Sharp Basic allows lines to be accompanied by a label as well as a line number. They are used here because they enable direct entry to be made into these routines from the keyboard. A number of programmable calculators also have this facility. The label C is used to enable continuation of the program; F is used at the Finish of the program to examine the items in the memory; and S is used in the Search mode.

Sharp Basic only allows one-dimensional arrays using the identifier A: so A(5) is allowed, but B(5) is not. Unfortunately the variables A(1) to A(26) overlap the variables A to Z, as do the string variables A$(1) to A$(26). Since the program uses the variables A to E, the first usable array variable is A(6).

The program stores the item price and number of items in A(6) to A(55), and the item name in A$(56) to A$(105). If the array is nearly full a warning is printed, otherwise a system error would soon be generated.

To save space in the listing the price of each item and the number purchased are packed into a single variable. The program cannot cope with single items costing over £100.

Picture routine

THIS PROGRAM BY J J C Fenton of Edinburgh can be used to draw a picture and then to put it into Data statements for later use or incorporation into another program. In line 110, you are asked whether you want to display a picture currently in the program, or start a new one.

In lines 130 to 280, a new picture is drawn, or an old one added to. The arrowed keys move the line being drawn continuously in the required direction, and diagonals can be drawn by pressing two of these keys at once. To see how this works, experiment with the effect on Peek (14400) of pressing various keys.

The lines are drawn by the Set function. If 1 is pressed, the line is not drawn, but a flashing dot moves across the screen which can be used either to erase or to leave a gap. Pressing 1 again returns a visible line. With practice, you will be able to use the full graphics capabilities of the system.

In lines 290 to 330, if Newline/Enter is pressed, the picture is recorded into the Data lines 1 to 48 by Poking into the program itself. Listing the program will show the interesting result. A count from 1 to 48 at the bottom of the screen shows progress, and then you can either clear the screen and re-Print the picture or return to the start of the program to alter the picture.

Lines 340 to 380 copy the picture currently in data on to the screen, then you can alter the picture if you wish. Pressing any key will remove this instruction. By deleting all but lines 1 to 48 and 350, the picture can be incorporated into another program.

Picture-drawing routine.

```
1 to 48 DATA , , , , , , , , , , , , , , , , , , , ,
  (each line must have DATA followed by 20 blanks seperated
  by commas)
100  CLS : DEFINTA-Z : P=14400
110  PRINT@965,"C = CURRENT, N = NEW";
120  X$=INKEY$ : IF X$="C" THEN 350 ELSEIF X$<>"N" THEN120
130  S=15360 : X=0 : Y=0 : N=0 PRINT@960,STRING$(40,128);
140  A=PEEK(P) : IF A=1 THEN 290 ELSE A=A/8
150  ON A GOTO 160,170,140,180,190,200,140,210,220,230 : GOTO 260
160  Y=Y-1 : GOTO 240
170  Y=Y+1 : GOTO 240
180  X=X-1 : GOTO 240
190  X=X-1 : Y=Y-1 : GOTO 240
200  X=X-1 : Y=Y+1 ; GOTO 240
210  X=X+1 : GOTO 240
220  X=X+1 : Y=Y-1 : GOTO 240
230  X=X+1 : Y=Y+1 : GOTO 240
240  IF X=-1   X=0 ELSEIF X=128 X=127
250  IF Y=-1 Y=0 ELSEIF Y=45 Y=44
260  IF INKEY$="1" THENIF N=1 N=0 ELSE N=1
270  IF N=1 SET(X,Y) : FOR Z=1TO10 : NEXT : RESET(X,Y) : GOTO 140
280  SET(X,Y) : GOTO 140
290  X=17134 : Y=17172
300  FOR V=1TO48 : PRINT@960,V;
310  FOR Z=XTOYSTEP2 : POKE Z,PEEK(S) : S=S+1 : NEXT Z
320  X=X+45 : Y=Y+45 : NEXTV
330  PRINT@965,"READY : C = COPY, A = ALTER";
340  X$=INKEY$ : IF X$="A" THEN130 ELSEIFX$<> "C" THEN340
350  CLS : FOR X=0T0959 : READX$ : PRINT@X,X$ : NEXT : RESTORE
360  PRINT@965,"READY : A = ALTER";
370  X$=INKEY$ : IF X$="A"THEN130 ELSEIF X$=""THEN 370
380  PRINT@960,STRING$(25,128); : GOTO 370
```

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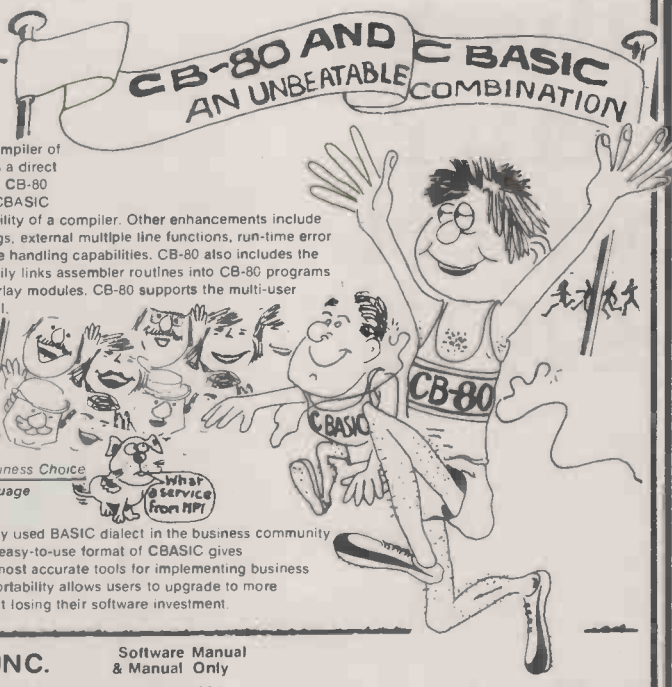

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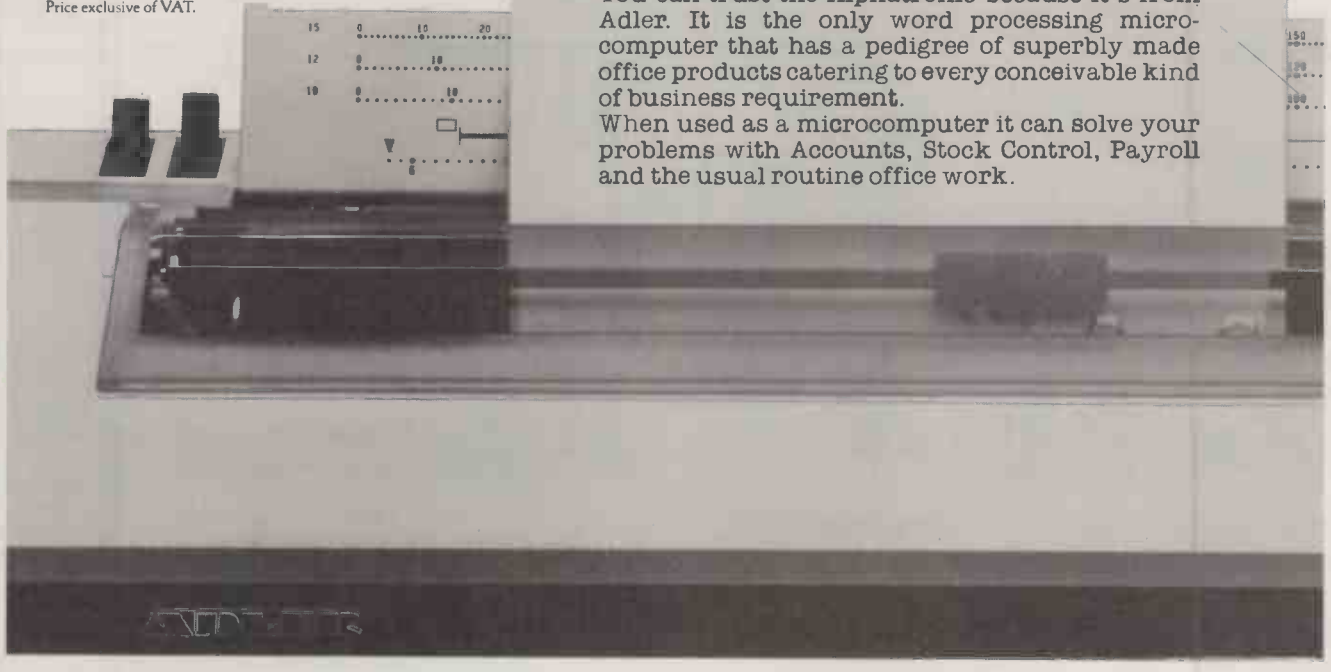

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● Circle No. 195

The Home Computer Handbook

By Frank Herbert and Max Barnard. Published by Victor Gollancz, £7.95. ISBN 0 575 03050 X.

FEW COMPUTER BOOKS have no redeeming features at all. Unfortunately, this text is just such a rarity. The whole attitude of the authors is that computing is a simple skill which the professional practitioners have deliberately and maliciously kept from the masses.

This is manifestly untrue. Programming is not simple, and most teachers of programming spend long hours trying to communicate a non-trivial intellectual discipline which many intelligent people find difficult. It is one of the most persistent and damaging myths of computing that programming is easy. Bad programming of trivial applications is easy. Producing good programs for non-trivial applications is hard.

Some of the statements the authors make are misleading such as "given the logical limits it must follow, your computer's accuracy approaches absolute. It will not make arithmetical errors". Others are simply wrong.

It rapidly becomes apparent that the authors have a fairly limited appreciation of what is happening in computer science. In their enthusiasm to debunk myths they sell computing short.

In terms of the personal computer itself there are some curious omissions and inclusions. The 8080 and LSI-11 are mentioned, but not the Z-80 or 6502. The only operating system which is specifically referred to is Unix — not a word on CP/M or the UCSD p-system. From this and other internal evidence I would guess that the material is five or six years out of date. It shows in such comments as in the discussion of storage media, in which cassettes are described as "more than adequate" for "most users". None of the advice on the choice of which computer to buy is sufficient to help the naive user faced with the current state of the art.

Much of the latter part of the book gives an elementary introduction to Basic and the authors' own idiosyncratic flowcharting method. In their discussion of Basic there is one comment I particularly treasure: "Goto is the 'debugger's friend' ". In reality it is the good program designer's enemy. The authors' method of flowcharting is devoid of any technical merit or advantage.

Conclusions

- **The text is not accurate.**
- **The information is out of date and incomplete.**
- **The parts of the book which deal with programming are technically unsound.**
- **Under no circumstances could this book be recommended.**

Michael Trott

From Chips to Systems

Second edition by Rodnay Zaks. Published by Sybex. 552 pages paperback. ISBN 0 89588 063 6

RODNAY ZAKS believes that microprocessors will "eliminate a large number of jobs" and that people will have to be educated in the workings of the chip if they are to find employment". He attempts to explain microprocessing so that it can be understood by those who have "no preliminary knowledge of computer or microprocessor technology".

Zaks seems aware of the barriers computer jargon can present: "Every effort has been made to define these words before they are used". At first he takes this to extremes — even explaining that bi-directional means "in both directions", but soon he forgets and launches into a stream of unexplained micro speak without even a glossary to help the uninitiated.

Beginners are likely to be put off before they even reach the excellent sections later on comparing different chips and showing how systems are assembled.

Zaks' first edition had little competition, and his guided tour around the internal architecture of a semiconducting chip proved very popular. In the meantime the handsbreath of micro titles on the shelf have spread across whole bookshops.

In the mid-1960s the modern textbook was invented. Communications theory ran riot on paper — wide margins sans typeface, acres of undistinguished diagrams and an exercise at the end of each chapter. At its best it was little worse than the rote learner it replaced; at its worst it looked like Zaks' new edition of his introduction to microprocessors.

If the first few chapters were rewritten and perhaps expanded and the book redesigned to make the text easier to read it could be recommended without reservation.

If you already know something of how the Z-80 in your Sharp works Zaks will clarify the exact processes and also show how it differs from the 6502 in your mate's Atom. Zaks is held in sufficient respect in the industry to be able to comment honestly on the virtues and vices of rival products.

Conclusions

- **Not recommended for complete beginners because of poor presentation, confusing explanations of elementary concepts and lack of a glossary.**
- **If you have an elementary understanding of the internal workings of a microprocessor, or are prepared to persevere, this book should leave you with a clear idea of how different chips really operate.**
- **It includes a valuable critical assessment of rival manufacturers' claims for their slices of silicon. Rodnay Zaks is not afraid to call a copy a copy, or a "feature" a bug.**

Meirion Jones

Pet Basic: Training Your Pet Computer

By Zamora, Albrecht and Scarvie. Paperback; £9.70. Hardback £13.45. Reston.

YET ANOTHER introduction to Basic programming, in this case with special reference to the Pet. With so many similar books available it is very difficult for the authors to provide anything original. The approach is fairly typical of its kind, although the emphasis on techniques for games programs rather than the numeric or business +1 type application which tends to be favoured by other introductions to programming.

The text proceeds at a leisurely pace, and the more experienced programmer will find it irritatingly slow. For the complete novice it shoud be ideal. At the end of each chapter there is a summary of the ideas introduced, and exercises to test the readers' understanding of those ideas. Answers are provided. The book is informal in style; the emphasis is very much on learning by doing.

The coverage of string handling and graphics is excellent, and numeric methods are not ignored. There is a good coverage of multidimensioned arrays and their application to business-type problems. Scattered through the text are ideas for using the Pet in connection with hobbies and so on.

The book is generally well written and accurate except for the occasional printing error. Its main failing is that it provides little or no help on program design. This is a common omission in introductory programming tests, yet the question "How do I start"? is asked too often to be ignored.

Conclusions

- **A competent and readable introduction to Pet Basic programming especially for the complete novice whose first interest is in games.**
- **A useful book, but look at some of the others on the subject as there is such a variety of styles and emphasis that there may well be another book which suits your purpose better.**

Martin Wilson

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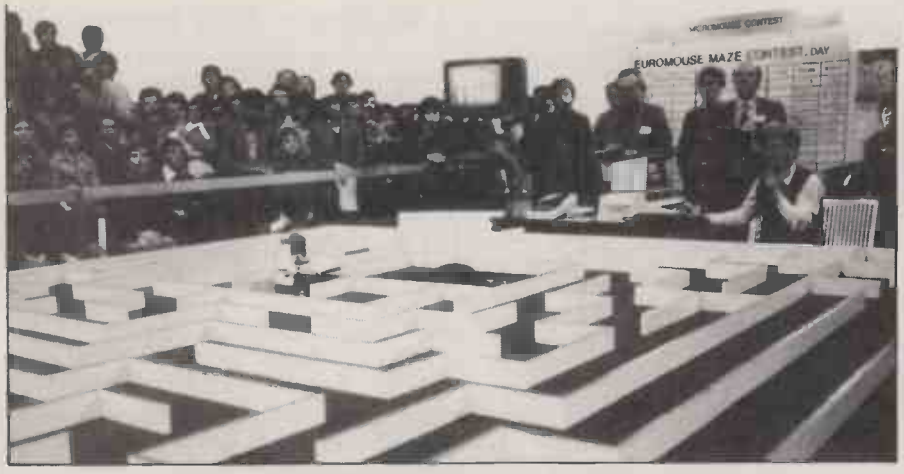
● Circle No. 196

Winner of the contest

John Billingsley reports on the winners of the British finals of the Euromouse Maze Contest.



A NAIL-BITING FINISH to the British Finals of the Euromouse Maze Contest, held at the Computer Fair, saw Alan Dibley carry off both first and second prizes. With a time of 1 minute 13 seconds on its second run, T3 won Dibley the expenses-paid week in Israel, to compete at Haifa in the European Finals at Euromicro '82 in September. Son of Thezeus achieved a time of 3 minutes and 21 seconds to win one of the first Sinclair ZX Spectrum computers to come off the production line.

Student winner

First prize in the students' contest held on Saturday was won by Anthony Porter. Although his Maisey Mouse failed to reach the centre, it was a smart little mover with a clever escape routine to wriggle out of tight corners. Its performance was impressive enough to win Tony the BBC model B Microcomputer donated by Acorn.

The organisers of the Computer Fair provided some really impressive facilities for the contest. The maze was mounted in an arena which seemed half the size of a football pitch, surrounded by tiered stands of seats.

Alan Dibley's trio of Thezei underwent enormous software modification. The first time Son of Thezeus entered the maze, it embarked on a successful but lengthy quest for the centre, but on its second run it merely turned its face to the corner and sulked. A "eureka" and a software mod later, its subsequent run improved greatly on its first.

Saturday saw the judging of the schools' and students' heat. Four mice took part; Maisey, Major Tom, Quester and Mousalium. Quester featured a bounding progression, making reflex reactions to the walls. Mousalium's performance was even less impressive. At the first bend, Richard Blue leapt forward to lift the mouse over the wall, admitting that the mouse was quite incapable of turning a corner.

A more purposeful mouse entirely was Major Tom. With photoelectric sensors mounted on stalks, and looking like an angry black spider crab it set off into the maze, but trouble with the photocell adjustment marred the performance of a very likely-looking rodent which should do well in the future. Major Tom won its makers a ZX-81 presented by IT '82.

Quester was awarded £25-worth of books from McGraw-Hill, while Mousalium, although incomplete, won its makers a book of their choice from the Computer Bookshop on the strength of an ingenious wheel mechanism.

Tony Porter's Maisey explored the maze steadily for 15 minutes, sometimes lurching a little drunkenly but always in full control of itself. Its maze-solving powers unfortunately failed to match its control capabilities, but it was adjudged the clear winner of the BBC Microcomputer.

Nerves were at full stretch for the British Final on Sunday. The prospect of the arrival of Thumper had already scared off several of the more timid mice, including one past champion, and the field was reduced to seven. By midday Thumper had arrived, gliding slickly through the maze to put up times of 2 minutes 31 seconds, 1 minute 5 seconds and finally one minute dead.

Brainy Bricks

The judges were Professor Morley Sage of Southampton University, Chairman of the Control and Computing Division of the IEE; Lionel Thompson of HSDE, secretary-general of Euromicro; and Chris Hipwell, publishing director of *Practical Computing*.

The first to run was Phil Yeardley's Brainy Bricks. After a couple of minutes of restarts and adjustments Phil invoked the "three minute rule", withdrawing to run again after some running repairs.

Marvin set off up the straight, but at the first corner emitted a strange clicking and graunching sound. The motor threw off a drive chain and Marvin was laid to rest.

A revitalised Brainy Bricks now returned to the maze, its running time now limited to 10 minutes. After two more restarts it found its feet: "It knows where it is now", said Phil, and so it did. With a time of 4 minutes 53 seconds, and with just two minutes left on the master clock, Brainy Bricks reached the centre to thunderous applause.

Maisy Mouse then repeated its performance of the previous day. Lurching determinedly along, its mechanical sensors guided it to every corner of the maze except the centre.

Thezeus had put up a qualifying time of 9 minutes and 7 seconds. It now set off to plod wearily around the maze, leaving no corner unexplored. After eliminating all improbable locations it seemed resigned to accept that the target must be somewhere near the centre.

The champion

Son of Thezeus set off briskly, and within 3 minutes 21 seconds had reached the centre. Dibley carried it proudly back to the start, predicting, "It will take a little longer on its second run, but for its third run it will take the shortest path". He pressed the start button and Son of Thezeus turned its face to the corner and sulked. In the heat of battle Dibley had forgotten to load in the software modification.

Now it was the turn of the great Thumper to run. Gliding smoothly from square to square, Thumper proved that its unwelcome habit of colliding with the maze walls had been all but cured. The maze had been modified for the contest and the path was not an easy one to find, but after nearly six minutes of running Thumper was within 10 squares of its goal.

Then it stopped. Prodding its buttons produced no result. Everyone was speechless while Thumper burbled on happily throughout the anxious four minutes which followed. At last David Woodfield switched Thumper off and on again, and the mouse set off as though nothing had happened. With a six-minute run before it and with only five minutes remaining on the master clock, Thumper's hopes were doomed.

Alan Dibley now reappeared with T3, alias YetanotherThezeus, which took the form of a bewhiskered rodent sitting atop a curiously mis-shapen cardboard Spitfire. T3 reached the centre in 1 minute 44 seconds and then, after a little more exploration, achieved a time of 1 minute 13 seconds, establishing it as the champion of the afternoon.

Treble cross

by Tony Roberts

Clues

Across

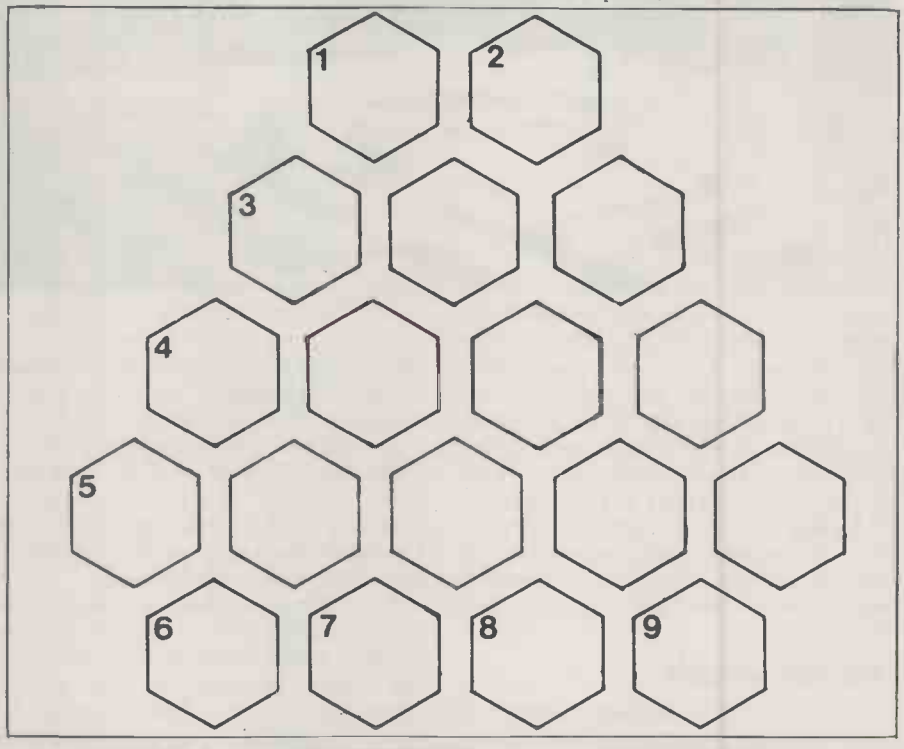
1. Mean of 5D and 9U.
3. See 5A.
4. See 5A.
5. Sum of all the other numbers less the three digit numbers, plus six.
6. Cube of 9U.

Up

5. See 5A.
6. Ten less than double the sum of 5D, 6A, 2D, 3A plus 3A.
7. See 5A.
8. See 5A.
9. See 6A.

Down

1. See 5A.
2. Square of 5D.
3. See 5A.
4. The product of the fourth root of 5D and the square of 9U.
5. See 2D.

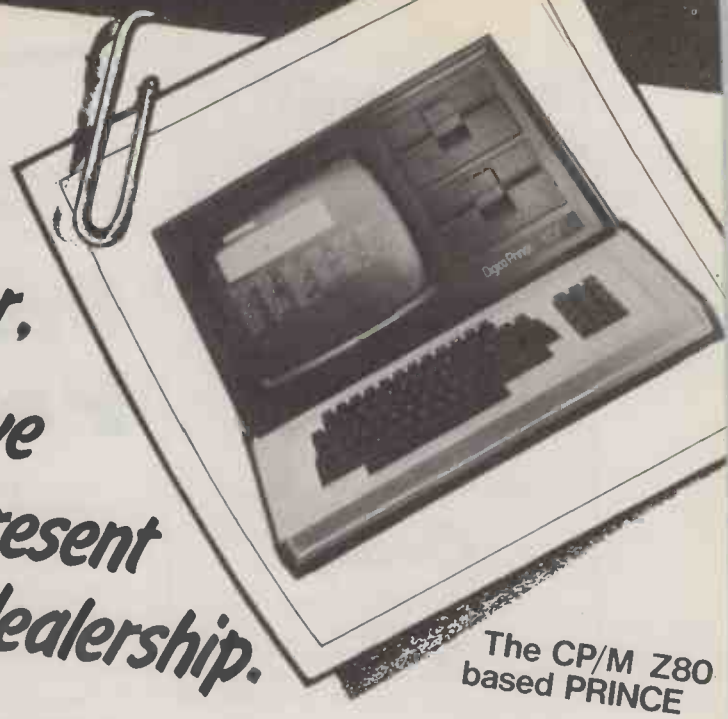


Solution to May puzzle

TO RESTORE the one-arm bandit to profit, the barmaid at the Knotty Ash Cybernauts Social Club changed one symbol on the centre reel: the symbol is the eighth, which was a plum, and is now a lemon.

Dear Computer Dealer,

We may well have obsoleted your present micro computer dealership.



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If your present micro supplier:

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2. Is not supported by an established British manufacturer with over 16 years computing experience.
3. Does not offer your users a growth capability.
4. Does not offer a minimum interruption plan during breakdown.
5. Does not provide comprehensive support for its dealers.

– then you could well be dealing with the wrong supplier.

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  Digico Computers have been in the business of computer hardware design, manufacture and maintenance for over sixteen years. With factories in Leeds and Stevenage, the Prince is fully supported in the United Kingdom.
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We're looking for the sort of distributor that can sell a real business machine and not leave the user to the mercy of a plaything.

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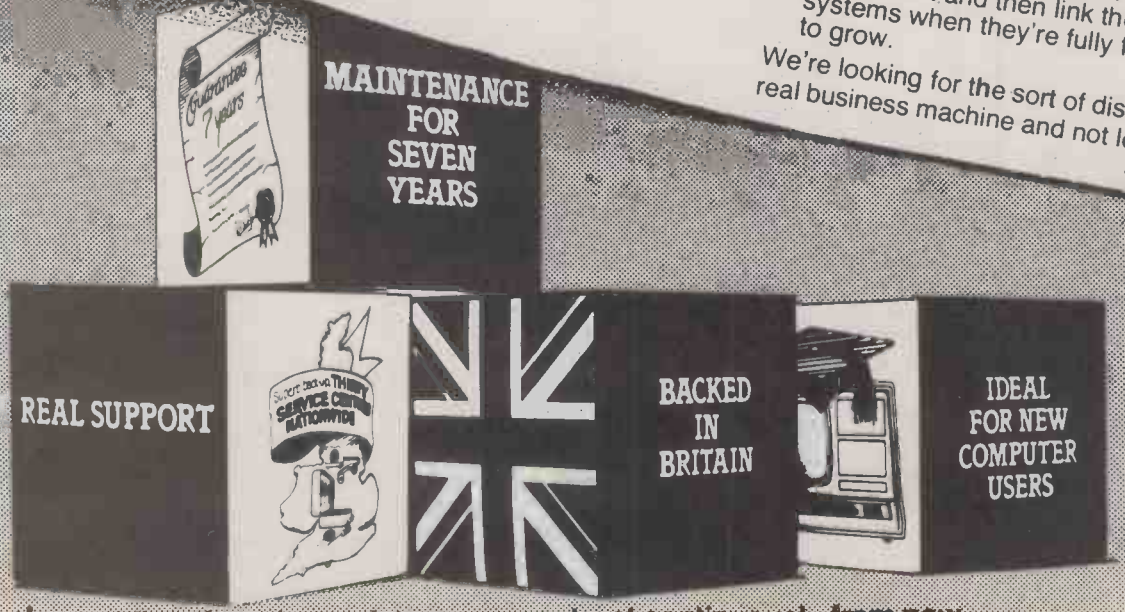

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These useful subroutines provide a dump for all current variables and arrays. P H Richards explains how they work by showing how Basic stores variables in memory.

Understanding Pet subroutines

VARIABLES MAY BE integer, string or floating-point. Additionally, arrays may be defined for any variable type. Information on simple variables is held in an area of memory starting at the address pointed to by the contents of memory locations 2A hex for the low byte, and 2B hex for the high byte. To convert to a decimal address from decimal pointers you should multiply the decimal value of the high byte by 256 then add the decimal value of the low byte.

For new-ROM Basic 2.0 the information on the variable is held in a seven-byte list in the storage area. The first and second bytes contain the name of the variable coded to also represent the type. The variable is assumed to have two characters in its name, with the second assumed ASCII 0 if not present. The variable A is stored as having the name 65 00 where 65 is the ASCII for "A".

The coding consists of adding 128 decimal to the ASCII value of either or both of the name bytes according to the type. In the case of an integer variable then 128 is added to the value of both bytes so that the name of the integer variable A% is stored as 193 128 decimal. Floating-point variables are not adjusted so that the variable A name is stored as 65 00. String variables have the second byte only adjusted so that the name of the variable A$ is stored as 65 128.

Integer variables have their current value stored in the third and fourth bytes of the header with the fifth, sixth and seventh bytes set to zero. This is why the maximum value limit on integers — since the high byte is signed — is 32,767. The byte in byte 3 of the list is the high byte of the value, byte 4 contains the low-byte value. The high byte is signed to indicate whether the integer is positive, or if the value is greater than 127, negative.

Decimal printout

Floating-point variables are stored directly in the remaining five bytes of the header as a signed, normalised binary. In the variable listing program a machine-code subroutine is used to access the section of the Basic interpreter which converts this to a decimal printout.

String variables are not stored with the name. The third byte of the list gives the current length of the string and the fourth, or low byte, and fifth, or high byte, give the location of the string in memory. Strings are stored at the top of memory. While the contents of the seven-byte block may vary, the length of the block is always seven bytes, making stepping from one block to the next a simple matter.

The block description of a defined array is not this simple. The contents of 2C hex (low byte) and 2D hex (high byte) point to the start of the array definitions. The first two bytes of an array block in the list are exactly the same as for the simple variable. The third (low) and fourth (high) bytes contain the value

Figure 1.

Low byte	High byte	Area
28	29	Start of Basic program
2A	2B	Start of simple variables
2C	2D	Start of array variables
2E	2F	Start of free memory
30	31	End of string space
34	35	Top of available memory

Figure 2.

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7	type
name	name	high	low	0	0	0	integer
name	name	expnt	normalised	binary	mantissa		floating
name	name	length	low	high	0	0	string

Figure 3a.

byte 1	byte 2	byte 3	byte 4	byte 5
name	name	low L.	high 1.	vectors

Figure 3b.

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7
193	128	161	0	3	0	3

byte 8	byte 9	byte 10	byte 11
0	3	0	5

```
63900 REMREMFNTO  1RETURN  POKESTOP  ##############
####################
63901 GETA$:A$=""
63902 DEFFNA(X)=PEEK(X)*256+PEEK(X-1)
63903 DEFFNB(X)=PEEK(X)*256+PEEK(X+1)
63904 SS=FNA(43):SY=0:FORI=1024TOSS
63905 IFPEEK(I)=143ANDPEEK(I+1)=82ANDPEEK(I+2)=69ANDPEEK(I+3)=77THENSY=I+4:I=SS
63906 NEXT
63907 V=FNA(43):VV=FNA(45)
63908 GOSUB63931
63909 L=V+2
63910 ONA-(1-(A>3))GOSUB63941,63943,63945
63911 V=V+7
63912 IFV<=VV-21THEN63908
63913 PRINT"DO YOU WANT ARRAY VARIABLES SAVED OR NOT"
63914 GETA$:IFA$<>"Y"ANDA$<>"N"THEN63914
63915 IFA$="N"THENEND
63916 V=FNA(45)
63917 VV=FNA(47):IFV>=VVTHENEND
63918 XX=FNA(V+3)
63919 GOSUB63931
63920 L=V+7+(PEEK(V+4)*2)-2
63921 J=PEEK(V+4):K=1
63922 FORM=1TOJ:K=K*(FNB(V+4+M*2-1)):NEXT:PRINTK:FORJ=1TOK:IFJ=1THEN63924
63923 L=L+A
63924 ONA-(1-(A>3))GOSUB63941,63943,63945
63925 NEXT:PRINT:PRINT
63926 V=V+XX
63927 IFV<VVTHEN63918
63928 END
63929 REM
63930 REM
63931 REM PRINT NAME AND FIND TYPE
63932 A=0:IFPEEK(V)>127THENA=2:REM INTEGER
63933 IFPEEK(V+1)>=128ANDA=0THENA=3:REM STRING
63934 IFA=0THENA=5:REM FLOATING POINT
63935 PRINTCHR$(NOT128ANDPEEK(V))CHR$(NOT128ANDPEEK(V+1));
63936 IF(NOT128ANDPEEK(V+1))=0THENPRINT" ";
63937 IFA=2THENPRINT"%  ";:RETURN
63938 IFA=3THENPRINT"$  ";:RETURN
63939 IFA=5THENPRINT"  ";:RETURN
63940 REM
63941 REM PRINT INTEGER ASSUME L IS POSN OF LOW BYTE
63942 PRINTFNB(L):RETURN
63943 REM PRINT STRING ASSUME THAT L IS AT 'LENGTH' BYTE
63944 PRINTCHR$(34);:FORM=0TOPEEK(L)-1:PRINTCHR$(PEEK(FNA(L+2)+M));:NEXT:PRINT(
HR$(34):RETURN
63945 REM PRINT FLOATING POINT ASSUMING L IS AT FIRST (EXPNTL) BYTE
63946 POKE2,INT(L/256):POKE1,(L-INT(L/256)*256):SYS(SY):PRINT:RETURN
63947 END
```

Figure 4. Variable dump routine.

to be added to reach the next block. The fifth byte gives the number of vectors in the array. For example, if an array is dimensioned A(5,5) then the value in the fifth byte is two. If A(5,5,5) then the value in the fifth byte is 3.

A series of two-byte blocks next detail the size of each vector in "reverse" order. For example, the array dimensioned as A(5,4,3) would have three blocks containing, in order, three, four and five as their values, stored as high and low.

Finally there is a series of blocks concerned with the value of each item of the array. For an integer variable the block will be two bytes, and for a floating point five bytes. In both cases the blocks contain actual array values. String blocks consist of three bytes. The first contains the length, and the second two are pointers to the string value.

The order of the blocks is that of the dimensions as arrayed. Where A(a,b,c) has been dimensioned, the first descriptor block will be for A(0,0,0), the second for A(1,0,0), the third for A(2,0,0) and so on up to the value of (a). After the element A(a,0,0) follows A(0,1,0) then A(1,1,0), A(2,1,0) and so on up to A(a,1,0). Then follows A(0,2,0), etc. up to the value of (b). The entire cycle is repeated for (c).

Figure 3c.

1	A%	(0,0,0)
2		1,0,0
3		2,0,0
4		3,0,0
5		4,0,0
6		0,1,0
7		1,1,0
8		2,1,0
9		3,1,0
10	A%	(4,1,0)
11		0,2,0
12		1,2,0
13		2,2,0
14		3,2,0
15		4,2,0
16		0,0,1
17		1,0,1
18		2,0,1
19	A%	(3,0,1)
20		4,0,1
21		0,1,1
22		1,1,1
23		2,1,1
24	etc. etc.	

Storage areas

Figure 1 shows the pointers to the various storage areas in Basic. Figure 2 shows diagramatically the storage of simple variables and Figure 3 attempts to shed light on the storage of array variables.

The pointer in bytes 3 and 4 give the total length of the array descriptor. If the array under discussion has N vectors, then byte 5 will contain N. Next will come a series of N two-byte blocks — high and low — containing

(continued on next page)

```
      PC   IRQ   SR AC XR YR SP
.;  C6FB E62E 2C 34 3A 9D FA
.M 0401 0453
.  0401  37 04 9C F9 8F 52 45 4D
.  0409  A5 01 A4 02 20 AE DA 20
.  0411  E3 DC 60 23 23 23 23 23
.  0419  23 23 23 23 23 23 23 23
.  0421  23 23 23 23 23 23 23 23
.  0429  23 23 23 23 23 23 23 23
.  0431  23 23 23 23 23 00 00 00
.  0439  9D F9 A1 41 24 3A 41 24
.  0441  B2 22 22 00 60 04 9E F9
.  0449  96 A5 41 28 58 29 B2 C2
.  0451  28 58 29 AC 32 35 36 AA
.?
```

Figure 5. Print floating-point number.

(continued from previous page)

values for the maximum dimensions of each vector in reverse order, i.e., bytes 6 and 7 hold the dimension of vector N; bytes 8 and 9 hold N–1, etc. At the end of these comes a series of blocks whose length will vary according to the variable type. Their function is the same as the appropriate bytes in the simple variable since the bytes hold either the value or pointer.

The array has three vectors — byte 5 — with the dimensions of each vector 3,3 and 5. Thereafter will follow a series of two-byte blocks carrying the current value of one vector/dimension stored as shown in Figure 3c. If you complete the sequence you should obtain 5×3×3, or 45 blocks.

The main routine in Basic is shown in Figure 4 and the first line contains a machine-code routine. The line numbering is for convenient appending. You must initialise all the variables used prior to entering the subroutine, by incorporating lines such as those numbered to 10 in the listing.

Lines 63902 and 63903 set up two functions to enable decimal addresses to be calculated from low/high and high/low pointers. In the absence of the "find code" subroutine, lines 63904 to 63906 locate the start of the machine-code routine. 63907 sets V to the start of simple variable storage and YY to the end — start of arrays. The call to subroutine at 63908 determines variable name and type by looking at the first two bytes of the block.

The variable name is then printed to screen, and flag A set according to file type. Pointer L is set in line 63909 to the start of the variable description. The subroutine at 63941 prints the value of an integer variable while that at 63943 prints a string and the graphic representation of all cursor movements. The sub-routine at 63945 sets the zero-page locations 1 and 2 to point at the floating-point number which is then printed by call to the machine-code routine.

On return from the appropriate subroutine, the pointer V is set to the next variable; simple variable blocks are all seven bytes long. The pointer is checked and if it has been stepped into the variable storage area in line 63912 the process is repeated for the next variable. The subroutine then determines whether an array dump is required, and terminates if not.

V is set to the start of array in line 63916 and YY to the end in line 63917, which also checks that there are arrays present. XX is set to the descriptor section of the block in line 63918 and the subroutine called in 63919 which prints the array name.

Line 63920 sets L as the length of this descriptor block, so L now points to the first array value block. Line 63921 sets J to the number of dimensions, or vectors. Line 63922 steps along the header block setting K to the maximum number of elements in each vector and then prints the total number of elements in the array. The For-Next loop from 63922 to 63925 prints out the current value of each variable in the array.

The machine-code routine shown in Figure 5 has been entered into a Rem line. Its purpose is to load the accumulator with the low byte, and Y register with the high byte, of the address of the floating-point number. Then two subroutines are called from the Basic interpreter: the first of them at $DAAE downloads the number to the floating-point accumulator, and the second at $DCE3 prints it to the screen.

The subroutine can be halted with no ill effects to the operating system by the Stop key, but if the machine-code routine is in operation the Stop command will be executed on completion of the current printout. The dump can be diverted to printer with a Cmd instruction. Make sure that you really want the array dump before calling it. Even a small array such as A$(4,2,2) has 45 lines of printout.

BUYERS' GUIDE

The Buyers' Guide to microcomputers is a summary of low-cost computers available in the U.K. It appears every third month; we add new computers and amend existing information, as by manufacturer. Agents are invited to contact *Practical Computing* with updates and additions.

Microcomputers

ACORN COMPUTERS

Systems 1, 2, 3, 4, 5: 6502-based. 1-32K RAM COS or DOS. Hex or full keyboard. Personal, scientific business or educational use. Disc module, CMOS RAM Card, 80-by-25 character VDU interface, 8K static memory, analogue interface, daisywheel printer interface, cassette interface, VDU, laboratory interface, in-circuit emulator, universal interface, PROM program, Econet interface, switched-mode PSU. Software includes, Pascal, Lisp, Forth, floating-point extension, ONLI extension. System 1-3 Reviewed September 1979.

From £65 for System 1 kit; £285 for System 2 kit; £670 for System 3 kit

Atom: 6502, 2-12K RAM, up to 40K external memory, full keyboard, Basic in ROM, high-resolution graphics, cassette and TV interface, parallel port, I/O lines. Should eventually be able to link into a ring. Acorn Computers Ltd., 4a Market Hill, Cambridge CB2 3NJ (0223) 312772. Reviewed November 1980.

From £130

BBC Micro: 6502A or Z-80, 2MHz, second-processor option with up to 96K RAM, 32K in normal operation, full keyboard, cassette and disc interfaces, Centronics type interface, A-D interface, integral loudspeaker and sound generator. Options include: clock, voice synthesiser, Econet, teletext adapter and a 16-bit processor. VDU; eight modes including text and colour. Reviewed January 1982.

£299 and £399

ACT SIRIUS

ACT Sirius: 8088 16-bit CPU, 126K to 1Mbyte RAM. 11in. swivel screen displaying 25 by 80 characters or 800-by-400 point high-resolution graphics, programmable type founts. QWERTY keyboard plus numeric keypad and function keys; all keys programmable. Sound synthesis. Integral dual 5.25in. floppies, 1.2Mbyte, 10Mbyte hard-disc option. Operating system is CP/M 86 or MDOS — IBM compatible micro operating system. Basic and Assembler supplied. Pascal, Fortran, Cobol, etc. available. Business and general use. Reviewed March 1982. ACT Microsoft Ltd, Radclyffe House, 66 Hagley Road, Birmingham. (021) 454 8585.

£2,395 for 128K RAM, dual-floppy based system with VDU

ADLER

Alphatronic: 8085A, 64K RAM. 24-by-80 character screen, full QWERTY keyboard with numeric keypad and function keys. Integral, single or dual 5.25in. floppy drives, 160K or 320K. CP/M, BASIC. Reviewed February 1982. Adler Business Systems Ltd, 27 Goswell Road, London EC1. (01) 250 1717.

From £1,600 for single-floppy

£2,345 for dual floppies, VDU and printer

ADVANCED MICRO TECHNOLOGY LTD

AMT100/200: Z-80A, 64-256K RAM, 8K ROM, S-100 bus. QWERTY keyboard with numeric keypad and function keys, 15in. screen. RS-232 and parallel interfaces. Dual 8in. floppy drives in 1Mbyte or 2Mbyte options. CP/M or MicroCobol operating system. Basic, Cobol, etc. Business use.

From £3,600 to £4,000

AMT 700: Multi user version of AMT 100/200 based around hard disc unit — 16Mbyte fixed, 16Mbyte removable, CP/M, MP/M or MicroCobol. Barcellos Ltd, Sandbach House, 8 Salisbury Road, Leicester (0533) 541574.

From £9,000.

ALAN PEARMAN LTD

Maple: Z-80A, 16-64K RAM, S-100 bus, CP/M, 8in. discs, RS232 serial and parallel. Sold mainly as Micro-APL system. Alan Pearman Ltd., Maple House, Mortlake Crescent, Chester CH3 5UR. (0244) 46024.

From £2,450

ALMARC

Almarc: Z-80, 64 512K, S-100 bus. RS-232 and parallel interfaces, any terminal. Dual floppy drives, 3Mbyte to 21Mbyte hard disc options CP/M, MP/M II. Business use Almarc Data Systems, Great Freeman Street, Nottingham. (0602) 52657.

From £2,300

ALPHA MICRO

AM-1010, AM-1051: WD-16, 64K-16MB RAM, S-100, four 8in. up to 90MB hard discs, RS232 up to 20 ports. Alpha Micro, 13 Brunswick Place, London N1 6ED. (01) 250 1616.

From £7,500

ALTOS

ACS-8000 series: Z-80, 64K RAM dual 8in. disc, single user. Z-80, 208K RAM, single floppy disc, 10-40 Mbyte hard disc, magnetic cartridge tape back-up, CP/M or MP/M. Business and scientific use.

From £2,300 and £6,800

ACS-8600 series: 8086 based, with 8089 DMA, 128K to 1Mbyte RAM, 10-80Mbyte hard disc, magnetic tape back-up, up to eight users, Xenix or MP/M-86. Business and educational use. Logitek Ltd, Logitek House, Bradley Lane, Standish, Lancashire WN6 0XQ. (0257) 426694.

From £8,950

APPLE COMPUTER

Apple II Plus: 6502, 16-48K RAM, 8K ROM, colour graphics, 5¼in. discs, general use. Own bus Basic, Pilot, Logo, Lisp, Forth, Pascal and most other languages available. CP/M available with add-on board with X-80 on it. Reviewed October 1979.

From £695

Apple III: 6502A with supporting chips, giving it a superset of 6502 instruction set. 96-128K RAM, colour graphics, integral 5¼in., RS232, four 50-pin expansion slots. Apple Computer (U.K.) Ltd., Finway House, Hemel Hempstead, Hertfordshire HP2 7PS. (0442) 48151.

From £2,496 with monitor and one floppy drive.

ARCHIVES COMPUTERS

Archive II and III: Z-80, 64K, 2K ROM, S-100 bus. Integral 25-by-80 character screen capable of 240-by-100 point graphics. Detachable QWERTY-keyboard with programmable function keys. RS-232, current loop and parallel interfaces. Dual 5.25in. floppy drives, 1.6Mbyte; Archive III has 5Mbyte hard disc. CP/M, Basic, etc. Business use. Salmon Electronics Ltd, PO Box 26, Croft, Darlington, County Durham. (0325) 721368.

£3,000 for Model II £4,000 for hard-disc Model III

ATTACHE

Attache: Z-80, 64K RAM, S-100 bus. RS-232 and parallel interfaces, any terminal. Dual 8in. floppy drives, 1.8Mbyte. CP/M, Basic etc. Colt Computer Systems Ltd. Fairfield Works, Fairfield Road, Hounslow, Middlesex. (01) 577 2686.

From £1,737 Floppy-based system, terminal and printer about £7,000

ATARI

Atari 400: 6502, 16K RAM, 10K ROM. Additionally uses 8K ROM cartridges for Atari-supplied software, mostly games or educational. Uses domestic TV for 24-by-40 character display with 320-by-192 point 16 colour high-resolution graphics. Touch-sensitive keyboard with full QWERTY layout. Four channel sound synthesis, cassette interface. Cassette audio track can be output through TV under program control. Home use.

From £300

Atari 800: 6502, 16-48K RAM. Expandable version of 400 intended for more serious user. Full QWERTY keyboard with moving keys, four function keys. 5.25in. floppy discs, 88K per drive, 176K dual unit. Basic, Pilot, Assembler available. Home, education and general use. Atari International UK Incorp., PO Box 59, Alperton Lane, Wembley, Middlesex, HA0 1FJ. (01) 998 8844.

From £600 for 16K RAM About £1,400 for twin-floppy based systems

BLEASDALE COMPUTER SYSTEMS

UDS: 8080, Z-80, 6809, 32K-IMB, Multibus, CP/M, 5¼in., 8in., hard, RS232, four parallel ports, IEEE 488, development system. Bleasdale Computer Systems, Francis House, Francis Street, London SW1. (01) 828 6661.

P.O.A.

BONSAI

SM-3000: Z-80, 64K RAM. RS-232, parallel and GPIB. 12in. 80-by-24 screen, QWERTY keyboard with numeric keypad. Dual 5.25in. floppies, 750K. CP/M, Basic etc. Business use. Bonsai Ltd, 112-116 New Oxford Street, London WC1A 1HJ. (01) 580 0902.

From £2,750

CANON

Canon BX-1: 6800, 64K RAM, 5.25in. integral floppy drive, RS-232, V-24 interfaces. Business use.

From £1,250

Canon CX-1: 6809, 124K RAM, 4K ROM, 12in. 80-by-24 character integral green screen with graphics capability, full QWERTY keyboard with numeric keypad, three RS-232 interfaces standard. Integral dual 5.25in. floppy drive, 620K; optional 2Mbyte 8in. floppies. Canon OS, Basic, 6809 assembler, Cis Cobol available. Business use.

From £2,850

Canon TX-10/TX-15: 6809, 16K RAM, 8K ROM, optional 16K non-volatile CMOS memory or 16K PROM. Integral 20-character strip display, no graphics. TX-15 has full QWERTY keyboard. TX-10 is numerically orientated, with numeric keypad and 30 program-definable keys. Optional two RS-232 interfaces, no discs, integral 26-column printer. Not user-programmable; the Basic or assembler programs reside in ROM or PROM. Intended for turnkey applications in business or scientific field. Canon (UK) Ltd, Waddon House, Stafford Road, Croydon Surrey CR9 4DD. (01) 680 7700. *From £1,250*

COLUMBIA DATA PRODUCTS

1500/1800 range: Z-80A, 64-256K RAM, 2K ROM, S-100 bus. Separate terminal. RS-232 and parallel interfaces. 5.25in. floppy drives, 8in. and hard-disc options. CP/M, MP/M. Basic, Pascal, Cobol, PL/1, etc. Business use. *From £2,200 for floppy-based single-user system £5,700 with hard disc*

DC 1000: Multi-user system. Each user has own Z-80A and 64K RAM under control of master Z-80A. One to 16 users, separate terminals, RS-232 and parallel interfaces. CP/Net. CP/M, MP/M, Basic, etc. Icarus Computer Systems Ltd, 27 Greenwood Place, London NW5 1NN. (01) 485 5574. *£7,500 single user, hard disc*

COMART

Communicator range: Z-80A, 64K RAM, S-100 bus, scientific, educational, research and business use. CP100/200; twin 5.25in. drives, CP-500; single 5.25in. and mini-Winchester hard disc giving 4.8byte CP/M, MP/M-II. Reviewed June 1981. *From £1,995*

COMMODORE BUSINESS MACHINES

Pet: 6502, 8-32K RAM, IEEE ports, integral 9in. screen, personal and general use. Reviewed August 1979. *From £460*

8000 Series — SuperPet: Upgrade of original Pet. 12in. screen, 5¼in. discs, business and general use. Reviewed October 1980. *From £895*

Vic 20: 6502, 5K RAM, 16K ROM, keyboard, personal and game use, IEEE interface, uses special cassette £35, disc and printer soon, RS-232, Modem use, low resolution colour graphics. Reviewed January 1982. Commodore Business Machines, 818 Leigh Road, Slough Industrial Estate, Slough, Berkshire. (75) 74111. *From £165*

COMPSHOP

UK101: 6502, 4-8K RAM, TV interface, RS232, full keyboard, single-board, personal use, similar to Ohio Superboard. Compshop, 14 Station Road, New Barnet, Hertfordshire EN5 1QW. (01) 441-2922. Reviewed May 1980. *From £199 for kit*

COMPUCOLOR

Compucolor II: Z-80, 8-32K RAM, 5¼in. integral discs, 13in. colour VDU, RS232. General use. Dyad Developments, The Priory, Great Milton, Oxfordshire OX9 7PB. (08446) 729. Reviewed June 1979. *From £998*

Copernicolor II: 8080A, 8-32K RAM, 5¼in., 8in. and Winchesters available, VDU, RS232 bus, standard ASCII keyboard with optional keyboards available, graphics 128 by 128, Basic, assembler, Fortran. Based on Compucolor II, wide range of software. General use. Copernicus Ltd., 7 Wey Hill, Haslemere, Surrey. (0428) 52888. *From £1,200*

COMPUCORP

Computext 655-685: Z-80A, 64-256K RAM, 2K ROM, S-100 bus. IBM-style QWERTY keyboard, 80-by-24 character screen or other screen options, RS-232, parallel and SCC interfaces. Dual 5.25in. floppy drives, 300K or 1.2Mbyte. Computext 685 has 5Mbyte hard disc. Compucorp Zebra generating system or CP/M. Basic, assembler. Fortran. Word-processing orientated business use. Compucorp Ltd, Barnet House, 120 High Street, Edgware, Middlesex HA8 7EL. (01) 952 7860.

£5,050-£5,986 for floppy-based systems £8,740 with hard disc

COMPUTER CENTRE

Minikit: Z-80, 16K RAM, serial and parallel, 5¼in., CP/M, S-100. *From £800*

Maxikit: Z-80, 16K RAM, serial and parallel, 8in., CP/M, S-100. *From £911*

Computer Centre, 9 De la Beche Street, Swansea SA1 3EX.

CROMEMCO

Single Card Computer: Z-80, S-100, 1K RAM, 20mA/RS232. OEM and industrial use. *From £273*

Z2: Z-80, 31A power supply, motherboard, 21 sockets, serious hobbyist and OEM use. Reviewed February 1979. *From £573*

Z2-H: Z-80A, 64-512K RAM, S-100 bus, CDOS, IOMB formatted fixed disc, two 5¼in. discs, hard discs up to 70MB. *From £5,373*

System 1: Z-80A, 64K RAM, S-100 bus, model CS-1; 790K storage, model CS-1H; 5.5Mbyte storage, CDOS and Cromix. *P.O.A.*

System 2: Z-80A, 64-512K RAM, S-100 21 slots, CP/M, VDU, two 5¼in. discs, hard discs up to 70MB. Multi-channel interface available. General/business use. *From £2,095 to £6,408 for seven users*

System 3: Z-80A, 64-512K RAM, S-100, CP/M, two or four 8in. discs, hard discs up to 70MB, general/business use. Datron Microcentre, 2 Abbeydale Road, Sheffield S7 1FD. (0742) 585490. Microcentre, 30 Dundas Street, Edinburgh EH3 6IN (031) 556 7354. Comart, P.O. Box 2, St. Neots, Huntingdon, Cambridgeshire PE19 4NY. (0480) 215005. *From £3,568 to £8,304 for seven users*

DANSK DATA ELEKTONIK APS

SPC/1: Multi-user system, one to eight users. 8085A CPU, 80-416K RAM, each user having 48K. Optional ROM up to 96K. Separate VDU, 256-by-256 point black/white graphics, 80-by-32 colour graphics characters. RS-232, parallel, IEEE-488, GPIB and other interface options. 280K — 1.2Mbyte 5.25in. floppy-disc configurations, 8in. and hard-disc options up to 26Mbyte. Mikados operating system, Comal, structured Basic, Pascal, assembler. Scientific, industrial and business use. Digital Data Electronics Ltd, Clark House, Pump Lane, Hayes, Middlesex. (01) 573 8854. *From £2,700 for single-user system*

DATA APPLICATIONS INTERNATIONAL

DAI Personal Computer: 8080, 48K RAM, 24K ROM. Uses standard TV, 16-colour 256-by-336 high-resolution graphics mode, QWERTY keyboard, RS-232 and dual cassette interfaces, DIN socket for sound output to domestic stereo, DCE bus for connection to range of over 20 Eurocard industrial interface modules. Optional dual 5.25in. floppy drive, optional CP/M, Basic, 8080 assembler, Cis Cobol available. High-speed hardware maths option. Home use, but also industrial scientific. Reviewed February 1981. Data Applications (UK) Ltd, 16B Dyer Street, Cirencester, Gloucestershire GL7 2PF. *From £595*

DELTA PRODUCTS

DPS Range: Z-80A, 64-640K RAM, 2K ROM, S-100 bus. Separate terminal. RS-232 and RS-422 interfaces. Dual 5.25in. floppy drives 1.5Mbyte 8in. and hard disc options up to 160Mbyte. CP/M, MP/M, CP/Net. Basic, Pascal, Cobol, PL/1, etc. Can be expanded to 10 users with CP/Net. Business use. Terodec Ltd, Unit 58, Suttons Park Avenue, Earley, Reading, Berkshire RG6 1AZ. (0734) 664343.

From £1,995 for floppy-based single-user system

DIGITAL DATA ELECTRONICS

SPC/1: 8085, 32-48K RAM, own OS, COMAL, Assembler and Pascal, graphics, up to three 5¼in. drives, up to four 8in. drives, 10MB Winchester, up to four 20MB cartridge, many ports. DDE, Clark House, Pump Lane, Hayes, Middlesex. (01) 573 8891.

From £1,995

DIGITAL EQUIPMENT CORPORATION

VT-18X: Z-80, 64K RAM, 8K ROM, RS-232 interface, dual 5.25in. floppy drives 360K. CP/M, Basic, etc, available. Intended for use with best-selling DEC VT-100 terminal — 80 by 24 characters, full QWERTY keyboard, various graphics options — to convert it into a personal computer. Business and scientific use. Zygal Dynamics plc, Zygal House, Telford Road, Bicester, Oxfordshire OX6 0XB. (08692) 3361.

From £1,800 for VT-18X alone. About £3,000 with VT-100 included

DIGITAL MICROSYSTEMS

DSC-3: Z-80, 64K RAM, CP/M, 8in. discs, hard discs up to 28MB, RS232/V24, business and general use. Two or more of these machines can be linked using HiNet local area network.

From £3,445

DSC-4: Z-80, 128-512K RAM, CP/M, 8in. discs, hard discs up to 28MB, RS232, RS422, business and general use.

From £3,995

Modata, 30 St. Johns Road, Tunbridge Wells, Kent TN4 9NT. (0892) 41555. Extel, 73/5 Scrutton Street, London EC2A 4TA. (01) 739 2041.

DURANGO

F85: 8085, 64K RAM, own bus and OS, graphics, four RS232 ports, integral 9in. VDU, 9 x 9 printer, keyboard and two 5¼in. disc drives. General use. Comp Ancillaries, 64 High Street, Egham, Surrey. (07843) 6455.

From £7,500

DYNABYTE

Dynabyte 5000: Z-80, 32-64K RAM, S-100, CP/M, MP/M, CP/Net, RS232, 5¼ or 8in. discs, hard discs up to 96MB, expands to multitask/user system. Business use. Microtech Ltd., Waterloo Road, Uxbridge, Middlesex UB8 2YW. (0895) 58111.

From £1,600 to £12,000

EACA

Video Genie EG3003: Z-80, 16-48K RAM, S-100, CP/M, 5¼in. discs, RS232, personal and general use. Lowe Electronics, Bentley Bridge, Chesterfield Road, Matlock, Derbyshire DE4 5LE. (0629) 4995. Reviewed February 1980.

From £369

EQUINOX

200: Z-80, 64-512 RAM, S-100 bus, CP/M, Omnix, MicroCobol, MVT FAMOS, cartridge disc, six serial and one parallel port, business use. *From £7,500*

300: WD-16, 64-256K RAM, S-100 bus, CP/M, Omnix, MicroCobol, MVT FAMOS, cartridge disc drive, six serial ports, business use. *From £10,500*

Equinox, 16 Anning Street, New Inn Yard, London EC2A 3HB. (01) 729 4460/(01) 739 2387.

EUROCALC

Euroc: 8080, 64K RAM, 8in. discs, 15in. VDU, CP/M, business use. *From £8,000*

Eurocalc, 55/56 High Holborn, London WC1. (01) 405 3113.

EXIDY

Sorcerer: Z-80, 48-55K RAM, S-100, RS232, CP/M, 5¼in. discs, MBasic, CBasic, Pascal, Algol, Fortran, Cobol, plug-in ROM pack programs, Separate VDU. Liveport, The Ivory Works, St. Ives, Cornwall TR26 2HF. (0736) 798157. Reviewed May 1979. *From £749*

HAYWOOD

Systems 1000-8000: Z-80, 32-65K RAM, 6000 is S-100, 3000 single-board, CP/M, graphics, 5¼in. discs, three serial and parallel ports. Business, scientific and general use. Haywood Electronics Assoc., Electron House, Leeway Close, Hatch End, Pinner, Middlesex HA5 4SE. (01) 428 0111. *From £2,359*

HEWART

6800Mk II: 6800 single-board, 1K monitor, 1K user RAM, 1K VDU RAM, 128byte scratchpad, education and home user. S-50 bus. *From £155*

6800S: 6800, 16K monitor, 8K Basic in ROM, graphics, 5¼in. drive. *From £229*

Hewart, 95 Blakelow Road, Macclesfield, Cheshire. (0625) 22030.

HEWLETT-PACKARD

85A: 16-32K RAM, 32K ROM, IEEE 488, RS232, graphics, 5¼in. drives, integral 32 by 16 VDU, integral thermal printer, QWERTY and numeric keypad. Scientific use. *From £1,917*

HP-83: Similar to HP-85 but without integral printer or tape cassette drive. Reviewed April 1982. *From £1,486.*

HP-87A: HP custom CPU, 32K-544K RAM, 48K ROM, 4,320-character screen graphics, full QWERTY keyboard. RS-232, HP-1L, parallel eight- and 16-bit interfaces and GPIB. 5.25in. dual floppy, 540K; optional 5Mbyte Winchester with floppy backup. Some HP calculators can be connected through the HP-1L interface. HP operating system, CP/M optional. Basic, assembler, etc. Scientific, engineering and business use. *From £1,783 £3,357 for dual-floppy system*

HP-125: Two Z-80s, 64K RAM plus separate 10K display RAM, 32K ROM. 80-by-24 character integral screen, detachable QWERTY keyboard. RS-232 and GPIB interfaces. Integral thermal printer. 5.25in. dual floppies, optional 8in. floppies and hard disc. CP/M. Basic and other CP/M languages available. Professional and business use. Hewlett-Packard, King Street Lane, Winnersh, Wokingham, Berkshire (0734) 784774. *£3,418 with dual 5.25in. floppies.*

HYTEC MICROSYSTEMS

H-4500 range: Z-80A, 80K RAM. Integral 80-by-24 character screen, detachable QWERTY keyboard with numeric keypad. Integral dual-floppy drives, 1Mbyte or 2Mbyte, or optional 5Mbyte or 12Mbyte hard disc replacing one of the floppies. CP/M, Basic, etc. Use as stand-alone microcomputer or to emulate terminal connected to large computer. Aimed at users of ICL or Honeywell mainframes. Hytec Microsystems Ltd, 9 West Way, Oxford OX2 0JB. (0865) 726644. — *£3,750 for 1Mbyte floppy-based system £5,950 with 5Mbyte hard disc*

H-5000: Hytec's multi-user system, using hard disc and network controller to link several H-4500s or H-4000s, disc-less variant. — *£3,500 for hard disc and controller only*

INDUSTRIAL MICROSYSTEMS

Series 5000: Z-80, 16-56K RAM, CP/M, S-100, two or three 5¼in. discs, two serial and one parallel port, desk unit, business and general use. — *From £1,500*

Series 8000: Z-80, 64-256K RAM, S-100, CP/M, MicroCobol, MVT FAMOS, Omnix, two, three or four 8in. disc drives, two serial and one parallel port, desk unit, business and general use. Equinox, 16 Anning Street, New Inn Yard, London EC2A 3HB. (01) 739 2387/(01) 729 4460. — *From £2,500*

INTERNATIONAL BUSINESS MACHINES

IBM Personal Computer: 8088 16-bit CPU, 64-256K RAM, 4K or 16K video RAM, 40K ROM. Uses IBM monitor or domestic TV to display 25 by 80 characters, 640-by-200 monochrome high-resolution graphics or 320-by-200 colour graphics. Detachable QWERTY keyboard with 10 function keys and numeric keypad. RS-232 and parallel interfaces, five expansion slots. Integral dual 5.25in. floppy discs, 160K each, 5Mbyte up to 120Mbyte hard-disc options. CP/M 86 or IBM's MDOS, Basic and other languages. KGB Micros, 14 Windsor Road, Slough, Berkshire. (0753) 38581. Microcomputerland, 172 Tottenham Court Road, London W1. (01) 637 4071. — *From £2,800*

INTERTEC

Superbrain: Z-80A, 64K RAM, second Z-80A to handle I/O. Two RS-232 interfaces fitted, IEEE-488 and S-100 connector are options. Integral 80-by-24 screen, optional high-resolution graphics, integral QWERTY keyboard with numeric keypad. Built-in dual 5.25in. floppies in 320K to 1.5Mbyte options; 10Mbyte to 96Mbyte hard-disc options. CP/M. Basic, APL, Cobol, Fortran, etc. Business, professional and educational use. Reviewed April 1980. — *From £1,495 for 320K floppy based system*

Compustar: Multi-user system consisting of network of Superbrain-like terminals linked in daisy-chain fashion to a hard disc and controller. Each terminal has Z-80 and 64K RAM and can run CP/M. Four types of terminal, VPU 15, 20, 30 and 40, give a wide range of options. — *From £4,500 for two terminals plus 10Mbyte hard disc £1,200 for each additional terminal*

Encotel, Succombs Hill, Upper Warlington, Surrey. (01) 820 5701.
Icarus Computer Systems Ltd, 27 Greenwood Place, London NW5 1NN. (01) 485 5574.
KGB Micros Ltd, 14 Windsor Road, Slough, Berkshire. (0753) 38581.
Sun, 138 Chalmers Way, North Feltham Trading Estate, North Feltham, Middlesex. (01) 751 6695.

ITHACA INTERSYSTEMS

Pascal Micro DPSI: Z-80, 64K-1MB RAM, full IEEE S-100 bus, CP/M version 2.2, graphics, 8in. and hard discs, RS232, four parallel and two serial ports per S-100 board. Ithaca Intersystems, 58 Crouch Hall Road, London N8 8HG. (01) 341 2447. — *From £4,258*

JAROGATE

MP 5: Multi-user system. Each user has own Z-80B + 64K RAM and also own S 100 bus for add-on boards, under control of further Z80B on master board. One RS 232 and IEEE standard for each user. Any terminal, add-on graphics boards. Integral dual 5.25in. floppies, 780K, optional 12Mbyte hard disc. MP/M, CP/NOS, CP/M, Basic, Fortran, Pascal, Cobol, C, etc. available. Business, word processing, or scientific use. Jarogate Ltd, 197-213 Lyham Road, London SW2 5PY. 01-671 6321.

From £1,995 Typical three-user system with hard disc £7,465

KEMITRON ELECTRONICS

K-3000: Z-80A, 64-256K RAM, own bus. Two RS-232 interfaces fitted, IEEE-488, parallel, D-A, A-D and wide range of specialised interface boards available as options. Any terminal. Intergral dual 8in. floppy drives 2Mbyte, or 10Mbyte hard-disc option. CP/M or MP/M. Basic, Fortran, etc. Aimed at scientific, industrial or educational user.

K-2000: Z-80A, 16-64K RAM. Smaller version of K-3000 built around 5.25in. floppy drives. Two RS-232 interfaces, has eight free slots for specialised interface boards. Kemitron Electronics Ltd, 21-23 Charles Street, Heole, Chester, CH2 3AY. (0244) 21817.

£3,300 for 2Mbyte floppy-based system £6,050 with hard disc plus floppy £2,300 for sinle disc, counter/timer, parallel IO, ADM-5 VDU

KONTRON

PSI-80: Z-80A, 64K RAM, 16K video RAM, 16K ROM, ECB bus. Integral 9in. screen of 80 by 24 characters, QWERTY keyboard. RS-232 interface. Integral 5Mbyte hard disc plus one 5.25in. 300K floppy. KOS, a CP-M compatible operating system, Basic, Pascal, Fortran, Cobol available. Business use. Reviewed March 1982.

Kobus: Multi-user network system for PSI-80s. Kontron, PO Box 88, Kontron House, Campfield Road, St Albans, Hertfordshire AL1 5JG (0727) 66222.

£6,660 for hard-disc based system

LSI COMPUTERS

M-One: 8080, 8-16K RAM, own OS, dual Shugart 8in. drives, two serial and one parallel port, 12in. VDU and full keyboard. Business use.

From £5,995 with software package

M-Two: 8085, 64K RAM and 4K EPROM. Launched in December 1980. LSI Computers, Copse Road, St. Johns, Woking, Surrey GU21 1SX. (04862) 23411.

P.O.A.

MICRO V

Microstar: 8085, 64K RAM, three RS232, serial inputs, StarDOS, twin 8in. drives, general use. Data Efficiency Ltd., Maxted Road, Maylands Avenue, Hemel Hempstead, Hertfordshire. (0442) 63561.

From £4,950

MICROMATION

Mariner: Multi-user system based on M/Net. Each user has own Z-80 + 64K RAM under control of further Z-80 or master board. S-100 bus, RS-232 interface, maximum 16; parallel interface, maximum eight; tape streamer. Any terminal. Integral 8in. floppy drive 1Mbyte, up to 80Mbyte hard disc. MP/M, CP/M or DBOS, with ISAM support. Business or Scientific use. Rostronics, 115-117 Wandsworth High street, London SW18 4HY. (01) 874 1171.

From £3,950

MICROSOLUTION

British Genius range: Z-80, 64K RAM, CP/M, Basic, BCPL, Fortran, Cis-Cobol, dual 5.25in or 8in. discs or hard disc. RS 232 and Centronics interface, separate keyboard, 24-x-80-character screen. MicroSolution Ltd., Park Farm House, Heythorp, Chipping Norton, Oxfordshire, OX7 5TW. (0608) 3256. *From £2,850 to £7,000*

MIDWICH

MC: Z-80, 16K RAM, 12K ROM. Domestic TV or monitor used to display 40 by 24 characters, 60-by-80 low-resolution graphics. QWERTY keyboard. RS-232 and cassette interfaces, range of optional boards for specialised control applications; D-A, A-D, etc.. Own operating system, Basic. No discs yet, uses cassette. Aimed at educational and laboratory users. Midwich Computer Co., Hewitt House, Northgate Street, Bury St. Edmunds, Suffolk IP33 1HQ. (0284) 701321. *From £345*

MILLBANK

Millbank System 10: Z-80A, 64K. Integral 12in. screen 24 characters by 80. Full keyboard with numeric keypad and function keys. Two RS-232 interfaces and an RS-449 network interface; optional IEEE-488 instrument interface. Integral 5.25in. twin floppy disc drives, 700K. Option of 1.6Mbyte floppies or 5Mbyte, 10Mbyte or 5+10Mbyte hard-disc units. CP/M. Business use as stand-alone machine, or as front-end pre-processor connected to mainframe. Reviewed December 1980. Millbank Computers Ltd, Millbank House, Amyand Park Road, Twickenham, Middlesex TW1 3HN. (01) 891 4691. *From £2,995 to £4,775*

MITREFINCH

MF-3000: Multi-user system, from one to 32 users. 16-bit CPU, 64K to 1.25MByte RAM. Cartridge hard-disc unit, 5Mbyte+5Mbyte removable, with 20 to 400Mbyte hard-disc options. Business use. Mitrefinch Ltd, Tower House, Fishergate, York YO1 4KA. (0904) 52995. *From £8,500*

NASCOM

Nascom 1: Z-80, 2-64K RAM, serial and up to 16 parallel ports, 8K Microsoft Basic, 1K monitor in EPROM. Personal use. Reviewed January 1979. *From £125*

Nascom 2: Z-80, 1K RAM expandable to 256 with Nascom System 80 case. Nasbus, 8K Basic, 2K monitor and 2K character generator, low/high resolution graphics and colour. 5¼in. single or twin floppy discs, RS232, parallel port, Kansas City cassette port. Lucas Logic Limited, Warwick, CV34 5PZ. *From £295*

NEWTRONICS

Explorer 85: 8085, 4-64K RAM, S-100 bus, RS232, VDU interface, CP/M, TV and cassette interface, personal and full business system. Newtronics, 255 Archway Road, London N6. (01) 348 3325. *From £146*

NORTH STAR

Advantage: Z-80A plus 8035, 64K RAM with 20K display RAM, twin 5.25in. discs. 12in. screen, 24 x 80 characters, 240 x 640 pixels, 87-key keyboard, graphics CP/M or graphics Basic/DOS, provided with Busigraph, diagnostic and graphics demo software. — From £2,195

Horizon: Z-80A, 16-56K RAM, 5¼in. twin drives, S-100 bus, own OS, business, educational or scientific use. Comart, PO Box 2, St Neots, Huntingdon, Cambridgeshire PE19 4NY. (0480) 215005. Equinox, Kleeman House, 16 Anning Street, New Inn Yard, London EC2A 3HB. (01) 729 4460. Reviewed April 1979. — *From £995 to £2,500*

OHIO SCIENTIFIC

Ohio Superboard and Challenger 1: 6502, 8K Basic in ROM, 2K monitor, 4K RAM, full keyboard and VDU interface. Hobbyist use. Reviewed June 1979. — *From £160*

Challenger 2: 6502, 48K RAM, dual 8in. drives, serial port, low-cost business use. — *From £1,500*

Challenger 3: 6502, Z-80 and 6800, 48-56K RAM, OSI 48-pin bus, serial port for VDU, CP/M, expands to eight users, 10, 20 and 75MB hard disc, business use. — *From £2,300*

Challenger 4: Similar to Challenger 1 but 64 by 32 display, colour and sound option. — *From £450*

CTS (0706) 79332. Reviewed September 1979. Mutek, Quarry Hill, Bath, Wiltshire. (0225) 743289.

OKI

Oki IF-800: Z-80A, 64-256K RAM, 16K or 48K video RAM, 2K ROM. Integral 24-by-80 character screen with 640-by-200 point eight-colour high-resolution graphics. Integral QWERTY keyboard with function keys. Numeric keypad. Built-in printer, speaker, clock. RS-232 and three slots for OKI boards — IEEE, A-D, etc. Dual 5.25in. floppies, 560K. 10Mbyte hard-disc option. OKI operating system, Basic or CP/M. Business or laboratory use. Reviewed April 1982. LSI Computers Ltd, Copse Road, St John's Woking, Surrey. (04862) 23411. — *£4,300 for system with dual floppies, VDU and printer*

OSBORNE

Osborne 1: Z-80A CPU, 64K RAM plus system software held in ROM in separate address space. Twin 5.25in. floppy-disc drives, 200Kbyte, integral 5in. screen displaying 24 by 52 characters at a time, full keyboard and numeric keypad, IEEE-488 and RS-232 interfaces. Portable; above configuration weighs 24lb. CP/M, with MBasic, CBasic, WordStar, Mailmerge and SuperCalc included in the price of £1,250. Reviewed February 1982. Osborne Computer Corporation (UK) Ltd, 38 Tanners Drive, Blakelands North, Milton Keynes, Buckinghamshire MK14 5BW. (0908) 615274. — *£1,250.*

PANASONIC

Panasonic: 8085, 56K RAM, full keyboard, integral 24 by 80 VDU, integral twin 5¼ or 8in. floppy drives. Three RS232, business use. Panasonic Business Systems, 9 Connaught Street, London W2. (01) 261 3121. Reviewed June 1979. — *From £4,150*

ATOM MACHINE CODE ASSEMBLER Includes: Machine Code Assembler, Single step (does not need VIAz, Memory Display/modify, Transfer, BRKP. Routine etc. Supplied with full instructions. Cassette in Library Case £6.20. ROM version (utillty socket) £11.50. Prices incl. of VAT & Post/Packing. For details of this and other Software, send r0p to:- JWB SYSTMS, 2-6 Churchill St., Newcastle-upon-Tyne, Tyne & Wear. (Mail Order only).

16K PET 3000 series. large keyboard plus cassette drive recorder & various programs. £395 o.n.o. Tel: 01-458 9711.

SIRIUS, hardly used, telephone 0492 67I88 after 6pm.

ATOM. Your Programmes printed for 1p. per line. minm £1m00. includes return of cassette. Pay W.D. Lowe, Holly Cottage, Sound, Nantwich. CW5 8BG.

SHARP PC1211 pocket computer and interfacve. £50. Tel: 01-904 8055.

ZX81 HARDWARE add-ons, circuit diagrams and assembly instructions for sale. Easily built by the electronics hobbyist. All circuits tried and tested. Repeat key facility £1.00. Programmable character generator/RAM-EPROM board £2.00. 16/32K RAM board £2.50. 16/32K RAM power supply £0.50. All prices inclusive. Send cheque or postal order or S.A.E. for details to:- Schematix, 39 Almond Ave, Dean Park Estate, Renfrew. PA4 0UT.

PET 4032. Mint condition. Save over £250 on list price. Bargain at £545. Tel: 061-904 9901

8K PET with 24K Petite add-on memory. New ROMs, Integral cassette, small keyboard, dust cover, some tapes. £400. R. N. Symington, Coopers Farm, Chiddingly, Lewes BN8 6HD. Tel: Chiddingly (082583) 237.

ACORN ATOM 1982 model, 12 + 12K, sound, colour, P.S.U., software, manual, extra book. £240. Tel: Malvern 61602.

HP41C PRINTER, Card Reader and 2 Memory Modules. Brand new, never used. Cost £453.90. Will accept £350 o.n.o. Tel: St Ives (Cambs), (0480) 64804.

8K PET, old ROM, second cassette and Okidata printer £350. Tel: Woking 62808.

16K ZX81 guaranteed until Jan. '83. Software includes 'Defender', Asteroids' and '3D monster-maze'. £75 o.n.o. Tel.: Tadworth 2410.

VIC20 Games (3.5K), 8 on cassette, including SPACEDEBRIS, MAZE, ALIEN ATTACK, CAVE, BREAKTHROUGH. Send cheque/P.O. for £5.95 to Paul Coldbeck, 3 Lune Avenue, Maghull, Merseyside L31 9DX.

Texas TI-99/4A with speech synth and extended basic, £350 ono. Tel: 01-928 8933 ext. 255.

Sharp MZ80K. Two superb new games. Trail and creatures. £4 each. P&P and cassette included. K. Sindall, 799 Dagenham Road, Rush Green, Romford, Essex.

16K ZX81, full size keyboard, graphics ROM, many programs. Worth £200, will sell £110. Phone 0277 72522.

PET 8K, new ROM, large keyboard, various books, external cassette. £350 ono. Tel: Cowdenbeath (0383) 510576.

PERFORMANCE BUSINESS MACHINES

PBM-1000: Z-80A, 80K RAM to 336K RAM by bank switching. RS-232 and parallel interfaces, separate terminal. Integral 5.25in. 800K floppy and 5Mbyte hard disc; optional 10Mbyte hard disc. CP/M, Basic etc. MNet for multi-user capacity. Word processing and general business use. Reviewed May 1982. Terodec Ltd, Unit 58, Suttons Park Avenue, Earley, Reading, Berkshire RG6 1AZ. (0734) 664343.

£4,200 for single-user system with hard disc, floppy and terminal.

POSITRON COMPUTERS

Positron 900: MC 6809, 64-512K RAM, 36K ROM. Separate VDU. Four RS-232 and one IEEE-488 interface, cassette interface. Dual 5.25in. 100K floppy-disc unit, optional 800K floppy unit, optional 5Mbyte hard disc. ROM contains OS-9 and Basic 09, a Unix look-alike. Pascal, Cis-Cobol, Fortran, C and assembler available. Business and scientific use.

£8,000 for four users, printer and hard disc.

Positron 9000: Similar multi-user Unix-look-alike system, but with colour and teletext capabilities and integral keyboard. Uses standard TV to display 40 by 24 viewdata-compatible characters in 7 colours, 240-by-240 point four colour graphics. Full QWERTY keyboard with numeric keypad, 12 function keys and Prestel keypad. Integral Modem and Prestel interface. Positron Computers Ltd, Unit 16, Deacon Trading Estate, Newton-le-Willows, Lancashire WA12 9XQ. (09252) 28828.

£2,870 single user, floppies, printer

RAIR

Black Box: 8085A, 64-512K RAM, mini-floppy discs, up to sixteen RS232C serial ports, 5MB and 10MB hard discs, IEEE 488 interface, CP/M and MP/M, general and business use. Rair, Wellington House, 6-9 Upper St. Martins Lane, London WC2H 9EQ. (01) 836 6921. Reviewed November 1979 and August 1980.

From £2,250

RESEARCH MACHINES

380-Z: Z-80A, 32-56K RAM, serial and parallel I/O, 24 by 80 and 24 by 40 VDU interface, separate keyboard, CP/M, twin 5.25in. or 8in. discs. Optional high-resolution colour graphics, IEEE-488, analogue I-O, 48- and 32-line parallel, local network interface. Scientific, colleges, secondary education. Reviewed December 1978.

£1,600 to £3,500+

480-Z: Z-80A, 32-256K RAM network machine two serial, one parallel, joystick interface, analogue output, 24 by 40 and 24 by 80 VDU output, TV output, TTL RGB colour monitor output, 1,200/300 bps cassette interface, sound. Optional Basic in ROM, high-resolution colour graphics, IEEE-488, local network transceiver, hardware floating point. Research Machines, Mill Street, Oxford OX2 0BW. (0865) 49866.

£550-£1,273

280-Z: Board version of 380-Z. Research Machines, PO Box 75, Mill Street, Oxford. (0865) 49791.

From £722 for 4K version

ROCKWELL

Aim-65: 6502, 1-4K RAM, full keyboard, RS232, discs, hobby use. Portable Microsystems, Forby House, 18 Market Place, Brackley, Northamptonshire NN13 5SF. (0280) 702017. Reviewed July 1979.

From £250

SD SYSTEMS

SD-100/200: Z-80, 64-265K RAM, 8K PROM, S-100 bus, RS232, CP/M, 12in. VDU, twin 8in. drives, business, industrial and general use. *From £3,750*

MS-610: Z-80A, 64-256K RAM, S-100 bus, CP/M or MP/MII, twin 8in. floppy drives, 1.2Mbytes; optionally up to 100Mbyte hard disc, any VDU. Circle Computer Sales Ltd, Unit 12, Woking Business Park, Albert Drive, Woking, Surrey GU21 5JY. (04862) 26881. *From £5,000 to £7,500*

SEED

System One: 6800, 22-56K RAM, 4K ROM, SS-50C bus. Separate VDU, 80 by 24 characters, optional 512-by-512 point graphics. RS-232 fitted, range of optional I/O boards. 5.25in. or 8in. floppy drives. Operating system is SSB DOS 68 or TSC Flex. Basic, assembler, educational, industrial, government or business use. *From £2,600 with terminal and floppies*

System 19: Multi-user system, one to 16 users. 6809 16-bit CPU, 48K to 1Mbyte RAM, 8K ROM, SS-50C bus. RS-232 interface, separate VDU. 5.25in. or 8in. floppies, up to 40Mbyte hard disc. Operating system is OS-9 or SSB DOS 69. Basic, Pascal, Cis-Cobol and C available. Educational, industrial, government or business use. Strumech Engineering Electronics Developments Ltd, Portland House, Coppice Side, Brownhills, Walsall, West Midlands WS8 7EX. (0543) 378151. *From £2,800 for single-user floppy-based system with terminal*

SHARP ELECTRONICS

MZ-80K: Z-80, 16-48K RAM, 10in. integral VDU, integral cassette, loudspeaker, 5¼in. disc optional, general use. *From £480*

PC-1211: Pocket computer. Programmable in Basic with cassette interface. Sharp Electronics, Sharp House, Thorp Road, Newton Heath, Manchester M10 9BE. (061) 205 2333. Reviewed July 1980. *From £85*

PC-3200: Z-80, attractive package for business use with separate keyboard and computer unit, printer, display and twin 5¼in. drives. Software now available on-line and conversion for CP/M being developed. *From £3,500*

SINCLAIR RESEARCH

ZX-81: Z-80A, 1-16K RAM, 8K Basic in ROM, cassette and TV interface, thermal printer at £49, touch-sensitive keyboard, education and games use. Animated-display facility. Two modes, fast with screen blinking, slow without. Reviewed June 1981. *From £49 for kit*

ZX Spectrum: Z-80A, 16-48K RAM, 16K ROM. Uses domestic TV for 24-by-32 character display of 256-by-192 high-resolution eight-colour graphics. QWERTY layout keyboard with 40 upper/lower case moving keys. 10-octave sound generation, cassette and printer interfaces; optional RS-232 and network interfaces. Discs announced, printer available. Sinclair Basic with graphics commands. *From £125 for 16K RAM machine, assembled*

Sinclair Research, 6 Kings Parade, Cambridge CB2 1SN. Reviewed July 1980.

SINTROM ELECTRONICS

Perliflex 630/48: Z-80A, 32-48K RAM, S-100, CP/M, twin Micropolis 5¼in. discs, two serial and three parallel ports. *From £1,995*

Perliflex 1024/64: Z-80, 64K, S-100, CP/M, dual 8in. discs, two serial and three parallel. Sintrom Electronics, Arkwright Road, Reading, Berkshire RG2 0LS. (0734) 85464. *From £2,750*

ZX80 both ROM's, manuals, leads, etc. As new. £55. Tel: 059 581 202.

Nascom 2. 4MHz, 1200 baud, 32K RAM keyboard case, cassette player, programs, books, graphics, £300. 56 2114's 200ns, 4 2716 5V eproms £60. Tel: 061 773 6487.

Wanted. ZX80/81, Vic and Atom books. Half price for books in good condition. S.a.e. for buying/selling lists, or send books direct to:- Allan Guy, 24 Woodside Drive, Cottingley, Bingley, BD16 1RF.

Sharp MZ80K arcade games. Space Invaders, Defender and Breakout. All written in m/c with excellent graphics and full sound effects. Only £4 each or all three for £10. K. Orr, 75 Parkhall Road, London N2.

MICROTAN. Fully expanded Tanex. Basic. Toolkit. Cased. ASCII. Keypad. Monitor, Printer, keyboard sockets. 5A psu. Printer cable, £220. Bishop's Stortford 504805.

ZX system and accessories ZX81 £55. ZX 16K RAM £35. Toolkit EPROM £15. RD8100 8 interface motherboard £35. RD8180 light pen £28. Quicksilva prog. chrs £23. Full size keyboard £20. Scotch copier £65, rrp £79.95. Tel: Bingham (0949) 37127, after 5 pm. Mr D. J. Moody.

Tandy quick printer II. All leads and paper. E/I not needed, £80 ono. Tel: Bolton (0204) 27249.

Superboard II, 8K, cased, manuals, leads. £110. Tel: Waltham Cross 28877.

16K ZX81 good software including Quiksilva Defender, £89. Tel: 01-889 4002.

Ohio/compukit games software. Falklands battle, Bricksmash. Very Fast Life, Psycho Your Personal Psychologist, 8K. £3.50 each, £6.00 for 2 or 50p for details. Craig, 67 Kiln Ride, Wokingham, Berks.

CBM acoustic modems (2). Connect directly to IEEE bus for communication with other CBM or remote mainframe. £500 the pair or £275 each. Woking 61082.

Matrix Printer. Full 96 character ascii set plus dot programmable graphics plus eight user definable fonts. RS232, IEEE and Centronics interfaces included. Vgc. £200. Tel: 09322 44110 (Surrey).

£2 for both Invaders and Dogfight for 12k Atom. Superb graphics and sound. M. Hall, 22 Dalby Avenue, Bushby, Leicester LE7 9RD.

Better Apple II colour. Full modification details £3. 10 Applesoft Games disk £20. H. Hopkins, 117 St. John's Road, Exmouth, Devon.

16K ZX81 and £30 of programs, £80! Tel: Frinton 5015.

Sharp MZ48K computer plus extended basic., Space Invaders and other games. Excellent condition, £275. Buyer collects. Reading 29889.

TRS-80 Model I 48K and three disk drives. Assorted operating systems. Just serviced by Tandy. £1200 ono or separately. Tel: 08864 433.

Nascom 2, 32K RAM, nas-graphics ROM, 8K basic, 3 amp psu. Complete with manual, portable TV and cassette recorder. £350 ono. Tel: 06286 5505.

MZ-80K horse-race analysis. Winners galore. Cassette £5.75. Details: S.a.e. P. C. Birch, "Moorside", Woodlands, Wimborne, Dorset.

TUSCAN Z80, 8K RAM, 8K BASIC, Mint conditlon, fully working 12" Green screen monitor, various programs in basic on tapes. £500. Ring Dave on 226 1432 (daytime). 808 9121 (evenings).

PET 32K with cassette unit and manual. Toolkit and other ROMs. Software including games. £475. Require software for 80-column. Have 40-column software for sale. Tel: Blackpool (0253) 869108.

Tipped-on A4 paper. 900 continuous sheets. Plain white. £30 ono. Bristol 502008.

Tipped-on envelopes. White 4.1/8" × 9½". 2 boxes × 1000. Unopened. £35 each ono. Bristol 502008.

Available for sale — a Scripta RO daisywheel printer, 132 column loggerbacks Matrix Printer and 12" Black/White Video Monitor for Apple II. All subject of insurance claim. Offers to Eurocourse Ltd. Tel: 01-739 8692.

For the ZX81 (16K) — programs carefully designed for young people learning to read music. Your ZX81 can make home music practice fun. 3 cassettes: (1) practice reading in treble and bass clefs (2) practice reading in alto and tenor clefs. (3) learn note time values. Two programs on each cassette. Price: £5 per cassette or £12 for set of 3. Orders to Brian Negus, 19 Westfield Drive, Loughborough, Leics. LE11 3QJ.

Two No. VDU's Lear Siegler ADM3A £200 & £300 respectively. Three No. 5 Mb top loading data cartridges 24 sector, suitable for ampex/cde drives. Gribble, Booth & Taylor, Chard, Somerset. 04606 3806. Ref. RT.

ASR3300 Computer terminal — Hard copy on *any* paper; Paper tape data/program storage; 20mA Interface (RS232C available); Collapsible stand . . . Only £200. Tel. Haynes 235.

TRS-80 FRUIT MACHINE PROGRAM. Features: 4 reels, hold, nudge, profit score, gamble, collect and jackpot. £3.50 inc. P&P. S. J. Andrews, Barn Cottage, Grove Road, Carlton Colville, Lowestoft, Suffolk NR33 8HR.

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TRS-80 16K LEVEL II, tape recorder, tapes, books, magazines. £300. Glasgow 336 6747.

ZX81: All brand new and in boxes, bought April '82. ZX81, 16KRAM, Ferguson tape recorder + software, got receipts, cost £180, accept £120. Tel. 01-435 8189.

ATARI 800. 32K, 410 program recorder, joysticks, le stick, plus over £200 games software including missile command. Still under warranty. As new in makers' boxes. First £700 secures. Tel. 031-229 0388.

FOR SALE: 1 only Apple II 48K Autostart Rom, 1 only ITT 2020 48K Autostart Rom. Also 4 disc drives; 2 only printers; 1 only black and white TV viewer. All peripherals are compatible. The above are demonstration models at 50% off list price. Tel: 01-965 2482.

SIRTON COMPUTERS

Midas Range: Z-80, from 8K RAM, S-100 or IEEE bus, CP/M, MP/M, graphics, up to four 5¼ in. or 8in. drives, hard disc, RS232, 8-bit parallel, IEEE 488. Sirton Computers, Unit 14, 29 Willow Lane, Mitcham, Surrey CR4 4NA. (01) 640 6931. *£785-£2,150*

SMOKE SIGNAL

Chieftain 511-821: 6800/6809, 32-64K RAM, S-50 bus, Flex DOS68/68d/69 dual 5¼in., 8in., dual RS232, video board, wide range of options, general use. Windrush Micro Designs, Gaymers Way, North Walsham, Norfolk. (069) 245189. *From £1,807*

SOLID STATE TECHNOLOGY

Athena: 8085, integral dual mini-floppies and mini-cassette, and matrix printer, can be expanded with 10 micros beyond CPU. Memory to 1.2GB. Claims performance similar to DEC PDP-11/34. Butel-Comco, Unit 10, Garrick Industrial Centre, Garrick Road, London, NW9 6AQ. 01-202 0262. *From £3,000*

SORD COMPUTER SYSTEMS

M200 Range: Z-80A, 64K RAM, S-100 bus, Sord OS, graphics, 5¼in., 8in. or hard discs, two RS232, integral 80 x 24 VDU. Business use. Exleigh Business Machines Ltd, 11 Market Place, Penzance, Cornwall TR18 2JB. (0736) 66577. *From £1,850 to £6,950*

TANDBERG EDUCATIONAL DIVISION

Aecal: Z-80, 4-200K RAM, 10K ROM. Uses standard TV to display 48 by 16 characters or 96 by 48 graphic points. Other graphics options. RS-232 and parallel interfaces. Built around intelligent cassette recorder, can store and retrieve real audio voice and music under program control. Optional 5.25in. 340K floppy. Operating system similar to NASSYS 3. Basic, Pascal, Forth, Comal, Assembler. Aimed at educational and training user. *Typical price £850*

EC-10: Multi-user system. 8080, 64K RAM, 4K ROM. One integral 80-by-25 character screen, up to seven terminals can be added. Integral keyboard is full ASCII, integral 8in. floppy. Tandberg operating system, but CP/M available. Basic, Assembler, also Cobol, Pascal, etc. available Educational use. *About £3,500 for single-user single-disc system*

Tandberg U.K. Ltd, Revie Estate, Elland Road, Leeds 11, West Yorkshire. (0532) 774844.

TANDY

Model 1: Z-80, 4-48K RAM, RS232, Level I and Level II Basic in ROM, separate keyboard and 12in. VDU, parallel interface, small business and personal use. Reviewed November 1978. *From 249*

Model 2: Z-80, 64K RAM, integral 8in. disc, integral 12in. VDU, detachable keyboard, CP/M serial and parallel ports, Level III Basic, business use. Tandy Corporation, Tameway Tower, Bridge Street, Walsall, West Midlands WS1 1LA. (0922) 648181. Reviewed March 1980. *From £2,699*

Model 3: Z-80, 4-48K RAM, 12in. display, integral unit with slots for two 5¼in. drives, 65-key keyboard, 12-key data pad, printer interface, compatible with Model 1 software. *From £499*

TANGERINE COMPUTER SYSTEMS

Microtan 65: 6502, 1-48K RAM, Tanbus, IEEE 488, Tanbug in ROM (1K), Pixel graphics, 5¼in. discs, 32 I/O lines and three serial ports, from single-board upwards. Tangerine Computer Systems, Forehill, Ely, Cambridgeshire. (0353) 3633. *From £69*

TECHNALOGICS

TECS: 6800, 56K RAM, Basic and Prestel terminal software, RS232, two cassette ports, two parallel ports, 5¼in. discs. Technalogics, Windmill Works, Station Road, Swinton, Manchester M27 2BU. (061) 793 6323. Reviewed November 1979. *From £895 for kit*

TEXAS INSTRUMENTS

TI-99/4: 990 16-bit, 16K RAM, Basic in 26K ROM, high-resolution, colour graphics, up to three 5¼in. discs, joystick, cassette and other ports, RS232, personal use. Texas Instruments Ltd., Manton Lane, Bedford MK41 7PU. (0234) 67466. Reviewed August 1980. *From £299*

TRANSAM COMPONENTS

Triton: 8080, 32K RAM, CP/M, 1K TBIOS in ROM, up to three 5¼in. discs, or four 8in., serial and parallel ports. Reviewed December 1979. *From £296*

Tuscan: Z-80, 8-64K RAM, S-100 bus, CP/M, RS232, TV and cassette interface, from single-board, personal use to full business system. Transam, 59 Theobalds Road, London WC1. (01) 405 5240. *From £150*

TRANSDATA LIMITED

Cx502: Z-80A, 64K RAM, CP/M, MicroCobol, 8in. floppy discs, four V24/RS232 interfaces, "flexibus" multi processor architecture. Professional business and scientific use. Communications software available. *From £2,795*

Cx502-S: Z-80B,64-160K RAM, CP/M, MP/M, 8in. 2MB floppy discs, four V-24 serial interfaces. Professional and general use. *From £3,495*

Cx503: Z-80A, 64K-208K RAM, CP/M, MP/M, MicroCobol 20MB Winchester disc, 8in. floppy disc for back-up, four V24 serial interfaces. Business and general use. *From £6,490*

Cx504: Z-80A, 64K-208K RAM, CP/M, MP/M, MicroCobol 20MB Winchester disc, cartridge tape back-up, 8in. floppy disc, four RS232 interfaces. Business and general use. Transdata Limited, Battlebridge House, 87-95 Tooley Street, London SE1. (01) 403 5115. *From £7,990*

SHOPWINDOW

NASCOM 2, 32K, Verorack, fan, separate keyboard enclosure, 4MHz, 2400bd, graphics, Nassys 1/3, toolkit, Pascal, Zeap 2, Nas Dis/debug, £375 ono. 0632-844902 or 01-589 9608 Room 58.

APPLE SOFT programs on disk (Dos 33). Programs Include pie formulae, co-ord geometry, guess numbers, amongst others. Only £16. Contact David Tomkins, Leavalley, Confey, Lelxlip, Co. Kildare, Eire.

BBC MICRO SOFTWARE. Three games on one cassette. Zap, Snake, Space Cag, £4.50. Turland/Wright, 97 Heathcote Road, Leicester.

FOR SALE TRS 80 model I level II Basic, 16K with numeric pad. 64x16 screen (green). CTR 80 cassette recorder. Level I and level II instruction books. Level II Basic course on cassette. 8 cassettes.

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UK101, 8K cased with improved P.S.U. Newman Cegmon switchable with 32x48, 16x48 screen formats. 1 or 2 MHz clocks, software controlled cassette speeds, software. £230 ono. Tel: Southend (0702) 203204.

APPLE II EUROPLUS, 48K, disk drive, controller, colour TV, top games, wizardry, Alien Rain, etc. £900. Tel: 0977 554105 daytime.

UK101 GAMES. Send S.A.E. for details to P. Wadey, Holland Farm, Hilfield Lane, Aldenham, Hertfordshire.

HEWLETT PACKARD 85 computer for sale. Complete with ROM drawer, additional 16K memory module, printer plotter module and visi-calu plus, basic statistics and standard pac programs — £1,500. Tel: Cardiff 373043 (office hours).

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ZX81, 16K, both Sinc. built, PSU, manual etc. +programs, all vgc, £95. P. Leftley, Studio Cottage, Hillstreet, Calmore, Southampton SO4 2RX.

SHARP MZ80K Educational Software. Calorimetry £5, Galvonometers £5, Gas Laws £5, German Vocabulary Test (2 volumes) £7.50 per volume. Send for full details to QUALITY SOFTWARE, 21, Dunes Drive, Formby, MERSEYSIDE L37 1PE.

ZX81 TOPPIX. Detailed diy graphics update £2. 16K M/C easyloaders, load REMs without spaces anywhere in listing. Hex and decimal £4, or £2.50 each. All plus sae. N. J. Petry, 3 Lester Drive, Worle, Weston-Super-Mare BS22 0NG.

NASCOM 2, 32K RAM, NAS-graphics ROM, 8K basic, 3 amp psu. Complete with manual, portable TV and cassette recorder — £350 ono. Tel: 06286 5505.

ACORN ATOM 12K + 12K, VIA, PSU, software, leads. £260. 01-531 1033.

MZ80K USERS. 'Copy program'. Copies any software from monitor £6. 'Space Attack' (Knight's Forth) fast graphics £4 or both programs £8. P. Massey, 61 Green Avenue, Astley, Manchester M29 7FF.

ZX81 DATA: Provides read, data and restore statements (integral data values only) cassette £250. ACCOUNTS — budget your domestic or business spending. Saves datafiles separately from program. Cassette (16K) £3.45. A. N. Wilson, The Vicarage, Whitworth Square, Rochdale, Lancs., OL12 8PY.

SINCLAIR ZX-81, compatible Ferguson tape recorder, all leads, manual, 5 games and tapes. Tel: Sherston 702. Clark, Palmall, Grove Road, Sherston, Wilts — lot for £60.

PROGRAMS FOR primary schools by teachers for teachers. Suitable for ZX-81 with 16K RAM. S.A.E. for details. P. R. Greet, 300 Kingston Road, Leatherhead, Surrey.

CPM. For sale 10 licensed copies of CPM, still in sealed packets each complete with Digital Research Manuals. £80 each. Geoff Drake, 9 Hoylake Road, East Acton, London W3. 01-743 6331.

ZX81 OWNERS stand up! I want to hear from ALL ZX81 owners and anyone considering buying a ZX81. Write to:- (no stamp needed) David Weaver, Freepost, Aldershot, Hants, GU12 5BR.

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UK101, REPORICLE, a tiny editor, interpreter, compiler for writing video games. Supplied with a fast machine code game called KAMIKAZE and a comparison BASIC program called DEATH STAR. Unsuitable for WEMON. £13 inclusive. N. Johnstone, 59 Copeland Avenue, Mirehouse, Whitehaven, Cumbria.

SORCERER 32K, Basic Rompac, UHF modulator, manuals, club magazines, boxed. £339 o.n.o. Phone Slough 36864.

VECTOR GRAPHIC

Vector Z-80B range: Z-80B, 64-512K RAM, S-100 bus. Any terminal. Dual floppy drives, 5 to 32Mbyte hard-disc options. CP/M and X-CP/M multi-use operating system. Business and scientific use. *From £2,300*

Vector 4: Twin Z-80 and 16-bit 8088 CPU, 128-256K RAM. S-100 bus, parallel and two RS-232 interfaces. Integral 80 by 24 screen with 640-by-312 point high-resolution graphics, 16 grey scales and RGB colour output to optional monitor. Detachable full QWERTY keyboard with numeric pad and function keys. Integral dual 5.25in. floppy drives 1.2Mbyte or optional 5Mbyte hard disc plus floppy. CP/M, Oasis or MS-DOS. 8088 is used as fast disc controller when running CP/M. Basic, assembler, etc. Almarc Data Systems Ltd, Great Freeman Street, Nottingham NG3 1FR (0602) 52657. *£2,175 for floppy-based system*

£3,825 with 5Mbyte hard disc

WESTERN DIGITAL

Pascal Microengine: Single-board computer based on five-chip set which executes Pascal P-code directly. 128K RAM, two RS-232 and two parallel ports, floppy-disc controller on board. University and military users. *£1,650*

Supermicro 1600: WD-9000 chip set. Basically boxed-up version of Pascal Microengine. Dual 8in. 1.2Mbyte floppies, two RS-232 and two parallel ports. External VDU. UCSD Pascal operating system, Basic and ADA, MicroAda, available. *From £4,126 £6,130 with VDU and printer*

Modular Microengine: Same WD-9000 chip set as Supermicro 1600; 128K RAM, etc. Based around Sentinel bus rather than single board, so hardware is readily expandable. Dual 8in. Floppies or optional 10Mbyte hard disc. Pronto Electronic Systems, 466-478 Cranbrook Road, Gants Hill, Ilford, Essex IG2 6LE. (01) 554 6222. *From £5,305 for dual floppy version £7,480 with hard disc*

ZENITH

H8: Single-board WH8 assembled, 8080, 16K-65K RAM. Heathbus nine slots, cassette interface, nine-digit LED. *From £321*

Z89: Z-80, 16-48K RAM, CP/M, integral 5¼in. drive, optional dual external, two RS232, full keyboard, 12in. VDU. *From £1,570*

WH-11A: LSI-11, 16-bit 16-32K RAM, own bus and OS, optional dual 8in. drives, serial and parallel ports. Zenith Ltd., 11b Bristol Road, Gloucester GL2 6EE. (0452) 29451. (01) 636 7349. *From £1,250*

ZILOG

MCZ Series: Z-80, 64K RAM, RIO OS, Zilog bus, optional graphics, 8in. discs, and hard discs, four RS232, one parallel, stand-alone or networking. Zilog (U.K.) Ltd., Babbage House, King Street, Maidenhead, Berkshire. (0628) 36131. *From £3,000*

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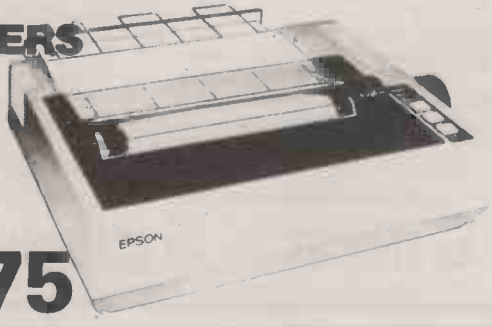

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LA120RA RO Terminal (NEW) £895
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LP04 900 1pm Drum Printer (NEW) £5,500
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VT50 DECscope Terminal E1A ... £275
VT52 DECscope Terminal (E1A or 20mA) £395
VT52 DECscope Terminal (NEW) £525
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BATTLE OF MIDWAY

Tony Dinsdale looks at a Second World War battle-simulation game.

A MAJOR DRAWBACK to serious computer war-gaming is the unsuitability of present monitors for displaying maps. Add the problems of internally representing terrain for movement and positions and you can forget about challenging manual games for authenticity. For these reasons, aerial, space and naval games are going to be the most accurate simulations on computers for some time to come.

Avalon Hill Computer Games has therefore picked a potentially good subject. Midway island is an important American air installation situated in the middle of the Pacific Ocean of obvious strategic importance. During 1942, the Japanese decided to invade the islands in order to increase their defensive boundary and cut the United States lines of communication. For this they assembled a carrier group of four CVs, a transport force for the landing troops and a task force of cruisers for escort. Opposing them, the Americans were badly deployed with only two carrier task forces and the air facilities of Midway itself.

Scanty intelligence

This is the position facing the American player against the inscrutable computer opponent at the start of the game. Although the game commences on June 3, the actual battle phase is normally entered over June 4-5, as per the historical action. This allows for some manoeuvring before wondering what hit you. Things are made difficult in general by the computer's miserly revelations of the Japanese whereabouts, and in particular, by the superior range of their aircraft.

Initially there are no enemy contacts, a position which is reverted to in the hours of darkness. A contact may be either anonymous or specific, that is, identified as the CV group, transports or cruisers, though it is really the carriers which will decide the outcome of the battle. Occasionally, a Japanese spotting plane is sighted overhead and you may expect it to have company soon. Whenever an air strike is launched, the opposition is automatically informed of the origin of the aircraft.

The whole game revolves around the position of the enemy carriers. Tactically, the only options open to you as the player, to combat the carriers are: course changes; deciding whether to have aircraft armed; whether to use fighters for combat air patrol (local defensive counter-air) or to escort strike aircraft; and when to launch strikes against the Japanese ships.

Midway itself is treated as an American carrier, the runway being substituted for a flight deck. The program is well designed for the input of commands. For example it is possible to arm aircraft on all the carriers in the American forces without having to specify the arm command separately for each ship. The ships must still be specified though and it would be nice if the two task forces could be automatically changed to the same courses rather than having to set the same course separately for each one.

Own goals

The best rule of thumb in this simulation is to shelter the carriers behind Midway. If all goes well and Midway is attacked, the range can be closed to the enemy carriers and a strike launched against them as they rearm on their wooden decks. Well, it makes good film scenes — the only trouble being that it often happens to the wrong side and carriers explode and sink at an alarming rate.

The tactical resolution of combat — AA, CAP, bombing, torpedo bombing — are all handled by the computer, so the role of commander is quite limited. Timing becomes the major criterion for success. Even so, a certain degree of satisfaction can be derived from reports of explosions aboard the enemy ships, while contemplating your own forces.

There are no obvious faults other than the limitations imposed by the game itself on the activities of the two sides. A possible engagement between the other ships involved — all the carrier groups had surface escorts — would have been a realistic diversification.

Conclusions

- The program appears to be bug-free. Validation of commands is also very good in that an incorrect command will not be accepted and treated as something else.
- Victory conditions are unfairly weighted in favour of the computer to counter the inferiority of the program strategy for the Japanese.
- The program is recommended as a serious simulation of the actual battle.
- **Ratings:**

Physical quality	**Very good**
Perceived complexity	**Low**
Subject complexity	**Fairly high**
Realism	**Good**
Play balance	**Good**
Overall	**Reasonable**

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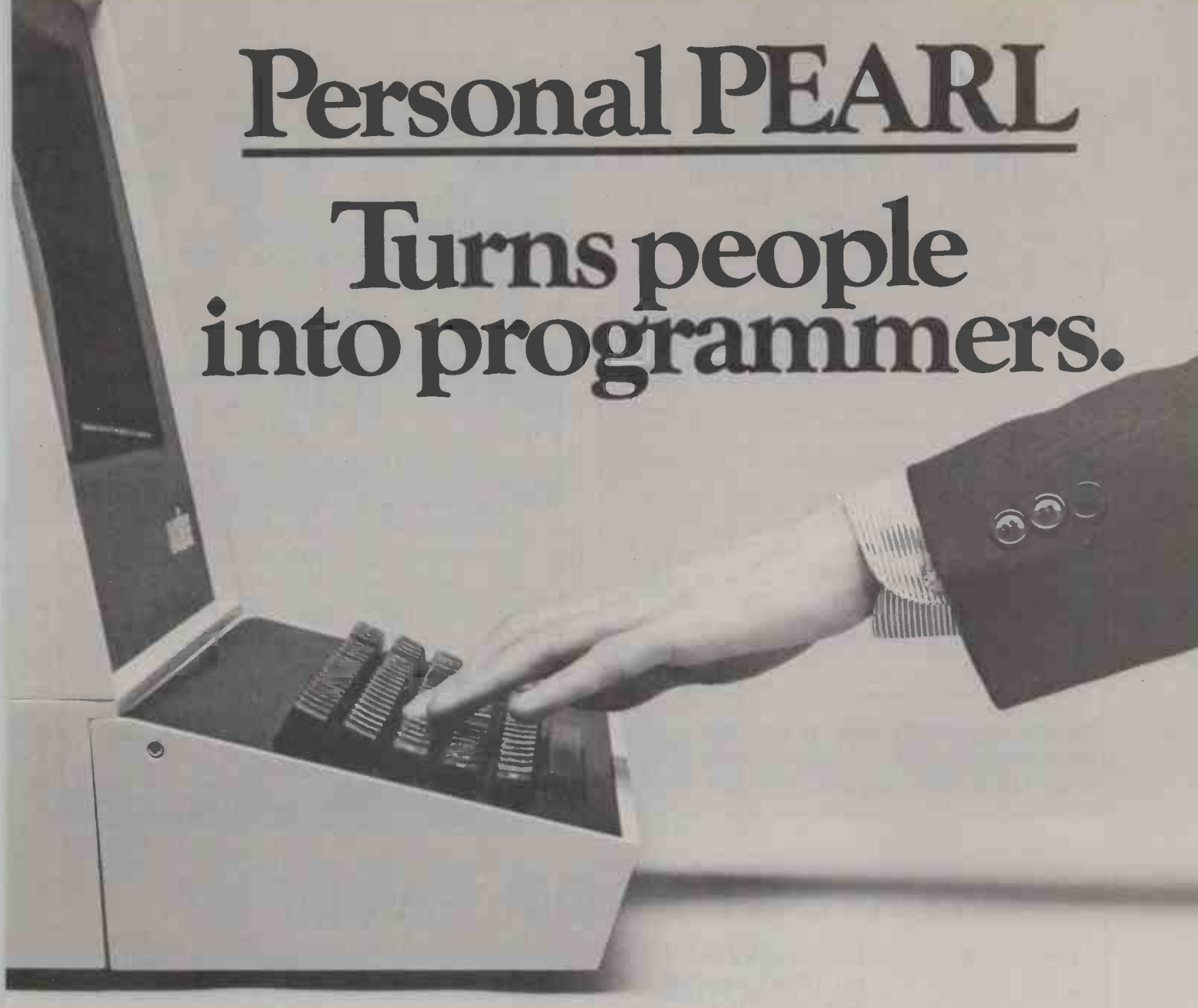

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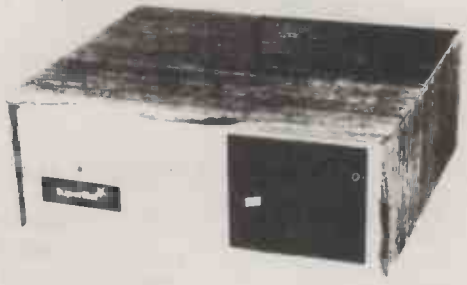

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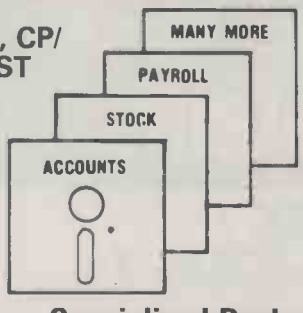

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74LS20	15p
74LS21	15p
74LS22	15p
74LS26	16p
74LS27	16p
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74LS30	15p
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74LS33	16p
74LS37	16p
74LS38	16p
74LS42	36p
74LS47	40p
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74LS114	30p
74LS122	42p
74LS123	50p
74LS124	120p
74LS125	30p
74LS126	30p
74LS132	45p
74LS133	30p
74LS136	30p
74LS138	34p
74LS139	36p
74LS145	75p
74LS147	160p
74LS148	90p
74LS151	40p
74LS153	40p
74LS154	90p
74LS155	40p
74LS156	40p
74LS157	35p
74LS158	36p
74LS160	40p
74LS161	40p
74LS162	40p
74LS163	40p
74LS164	45p
74LS165	100p
74LS166	90p
74LS170	90p
74LS173	70p
74LS174	45p
74LS175	50p
74LS181	140p
74LS183	250p
74LS190	50p
74LS191	50p
74LS192	50p
74LS193	48p
74LS194	40p
74LS195	48p
74LS196	60p
74LS197	65p

74LS221	60p
74LS240	70p
74LS241	70p
74LS242	80p
74LS243	80p
74LS244	65p
74LS245	90p
74LS251	40p
74LS253	40p
74LS257	45p
74LS258	41p
74LS259	80p
74LS260	24p
74LS266	25p
74LS273	70p
74LS279	45p
74LS280	250p
74LS283	45p
74LS293	50p
74LS295	200p
74LS298	160p
74LS299	400p
74LS323	250p
74LS324	150p
74LS348	150p
74LS352	100p
74LS353	100p
74LS356	250p
74LS363	160p
74LS364	160p
74LS365	32p
74LS367	32p
74LS368	36p
74LS373	70p
74LS374	70p
74LS375	50p
74LS377	70p
74LS378	60p
74LS390	55p
74LS393	50p
74LS395	190p
74LS399	200p
74LS445	110p
74LS540	135p
74LS541	135p
74LS640	200p
74LS641	200p
74LS642	200p
74LS643	200p
74LS644	250p
74LS645	250p

74LS668	200p
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74LS670	170p
74LS682	450p
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74S05	75p
74S08	75p
74S10	60p
74S11	60p
74S20	60p
74S30	60p
74S32	90p
74S37	60p
74S74	90p
74S85	300p
74S86	180p
74S112	90p
74S113	90p
74S114	90p
74S124	300p
74S132	160p
74S133	75p
74S138	225p
74S139	225p
74S157	250p
74S163	300p
74S174	250p
74S175	220p
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3245	450p
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3 276MHz	150p
3 5795MHz	100p
3 686MHz	300p
4 00MHz	150p
4 194MHz	250p
4 43MHz	110p
5 00MHz	175p
6 0MHz	150p
6 144MHz	150p
7 0MHz	150p
7 168MHz	200p
8 86MHz	175p
10 00MHz	175p
10 7MHz	250p
12MHz	350p
14 3168MHz	150p
16 00MHz	250p
18 00MHz	200p
18 432	250p
19 968MHz	390p
20 000MHz	175p
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27 145MHz	250p
38 667MHz	350p
48 0MHz	300p
55 5MHz	400p
116000MHz	350p

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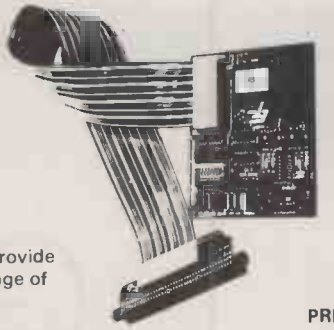

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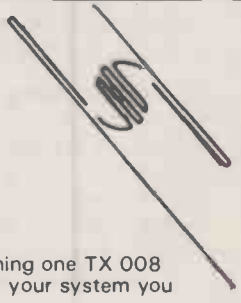

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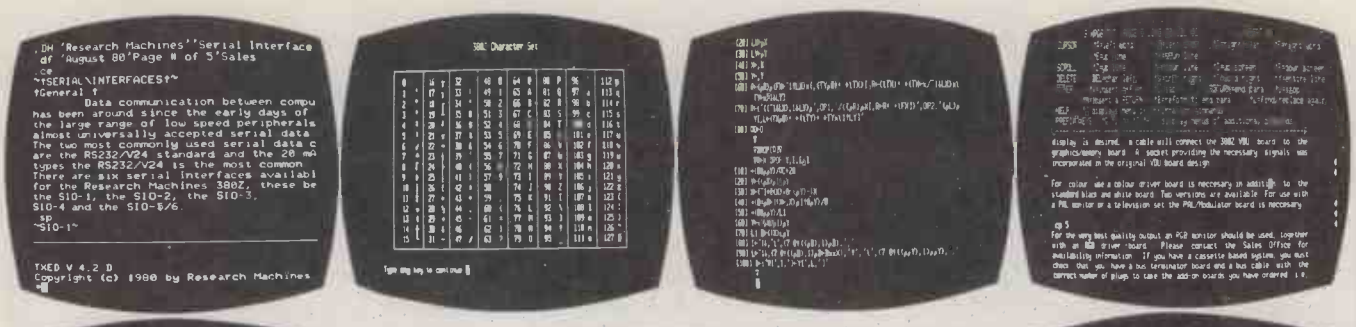

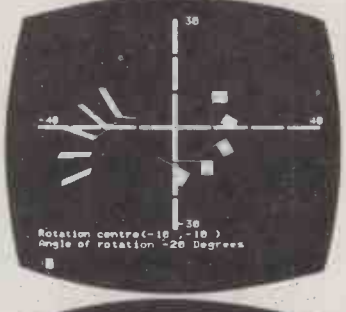

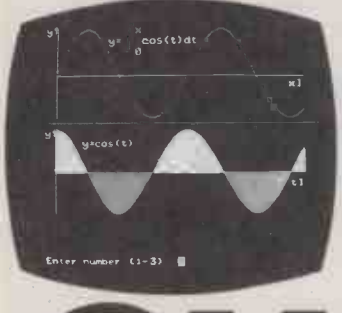

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